10 YEARS OF PUBLICATION

MANORAMA

TELL ME WHY

No:121

100 GREAT SCIENTISTS

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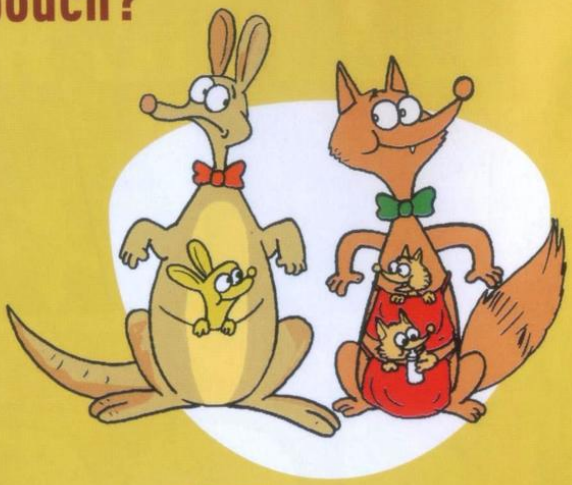

KNOWLEDGE MAGAZINE FOR CHILDREN IN **ENGLISH**

MANORAMA

TELL ME WHY

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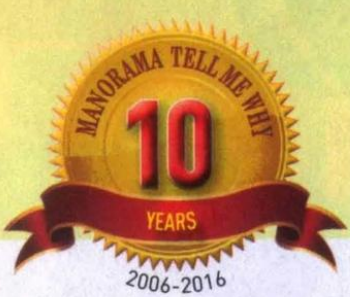
MANORAMA
TELL ME WHY
October 2016 • Volume: 10 • No: 10
FROM THE HOUSE OF MAGIC POT, THE WEEK, MANORAMA YEARBOOK, VANITHA & THE MALAYALA MANORAMA DAILY



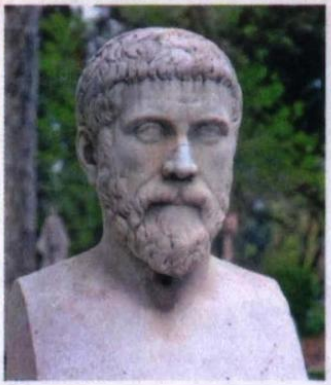
Tell Me Why has just completed ten years. On this occasion we pay homage to some great scientists who shaped the world.

PATHFINDERS

'If I saw further than others, it is because I was standing on the shoulders of giants,' Isaac Newton said once.

Thanks to various breakthroughs in science, people today enjoy a better quality of life. We prevent epidemics, invent new machines, and bring the world together with gadgets like the TV and computer. But these advancements did not appear magically out of nowhere. In fact, they were created by the unflagging efforts and struggles of dedicated men of science through the ages.

The following pages tell you about some of the great scientists.



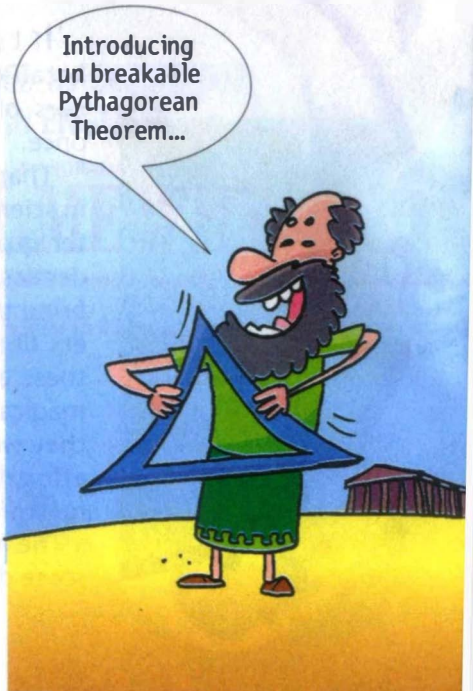
PYTHAGORAS

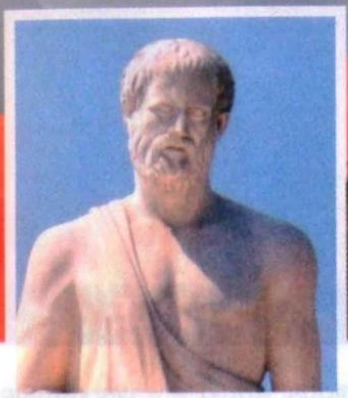
Why is Pythagoras considered one of the greatest scientists of all time?

Pythagoras was an Ancient Greek mathematician and philosopher who lived more than 500 years before Christ.

He spent most of his life in the Greek colonies in Sicily and southern Italy. He was also a philosopher, and founder of the religious movement called Pythagoreanism.

Pythagoras had a group of disciples who followed him around, and taught other people what he had taught them. He made crucial contributions to modern philosophy, as well as mathematics, science, and religious mysticism. It is also believed that he had a significant influence on medicine, music, astronomy, and divination.





HIPPOCRATES

Pythagoras is best known for the mathematical theory named after him. He is without doubt, one of the greatest scientists not only of the ancient world, but of all time.

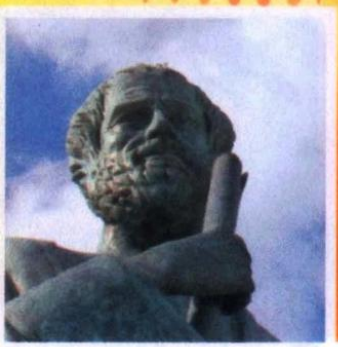
Why is Hippocrates called the 'father of western medicine'?

Hippocrates, a Greek physician, lived in the 5th century BC, and founded the Hippocratic School of Medicine. He revolutionised Greek medicine, for he believed in, and developed the practice of the clinical method of observation. This was the careful noting of all the symptoms of a disease, and of the changes in a patient's condition during the illness.

Hippocrates believed that the body must be treated as a whole. He made medicine a discipline distinct from other fields, and his biggest contribution was that he rejected superstition and the belief that supernatural, or divine forces, were the cause of illness.

In short, it was Hippocrates who transformed medicine into a science. He wrote on a variety of medical topics including diagnosis, epidemics, obstetrics, paediatrics, nutrition and surgery.

To this day, newly qualified doctors take an oath called the Hippocratic Oath that lays down the basic rules of conduct that doctors must follow.



ARISTOTLE

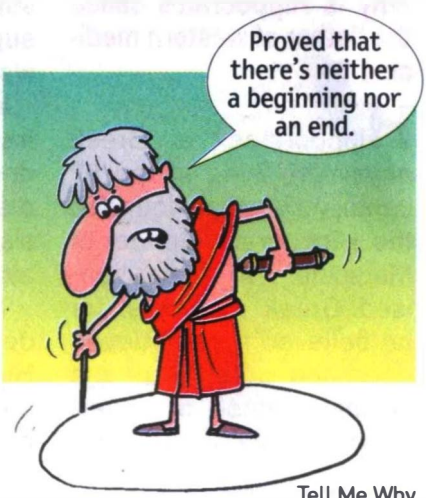
What makes Aristotle a giant among scientists?

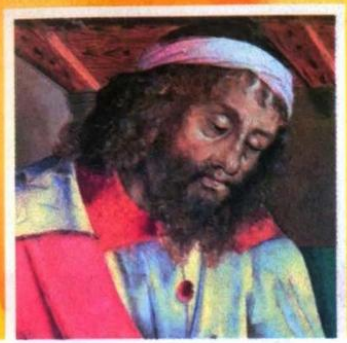
Aristotle was one of the most respected Greek thinkers. He was the star pupil of Plato, a famous Greek philosopher. He was also the teacher of Alexander the Great!

Aristotle wrote on many subjects including physics, biology, zoology, metaphysics, logic, ethics, aesthetics, poetry, theatre, music, rhetoric, linguistics, politics, and government.

He believed that the Universe was eternal, that there was neither a beginning nor an end. Aristotle accepted that things can change, but, fundamentally believed that the overall conditions would always remain the same. He studied zoology very closely, and through careful observation, he was able to arrive at his conclusions. His careful study of animals enabled him to classify them into different groups and species.

Aristotle's influence on western culture and science has been





EUCLID

enormous. His writings show him to be a man of tremendous intellect, who thought deeply about the world.

Why is Euclid called the 'father of geometry'?

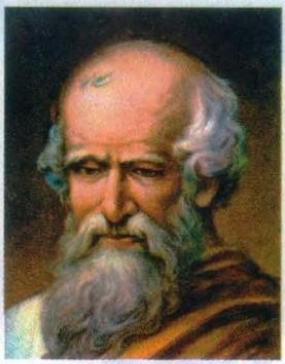
Euclid, who was born in Alexandria in Egypt, lived more than 300 years before Christ. He is renowned to this day for his book 'Elements'.

For centuries, this book was one of the main texts for teaching geometry. 'Elements' is divided into thirteen books, which cover plain geometry, arithmetic and number theory, irrational numbers, and solid geometry.

Man with No Roots

Very little is known about Euclid's personal life. The first references were made about him many years after his death. However, his work is immortal.

His books begin with basic definitions, and then go on to prove different mathematical theories. So, it is only natural that Euclid is called the father of geometry. He stressed the importance of logic and reason in teaching and understanding maths. Though some of his books are lost, at least five of them are still in existence, and are proof of his remarkable gift for mathematics.



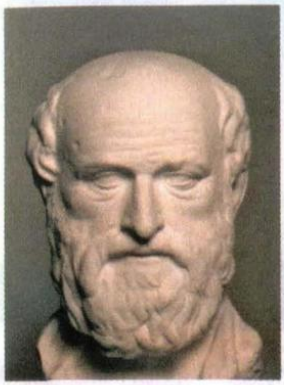
ARCHIMEDES

What are the major contributions made by Archimedes?

Archimedes is best remembered as an ancient Greek scientist who made legendary contributions to mathematics, physics, engineering, and astronomy. Archimedes, who lived about 300 years before Christ, is also remembered for his discovery of the relation between the surface and volume of a sphere, and its circumscribing cylinder.

He played a major role in developing calculus and analysis. This scientist explained how levers worked, and built war machines. But, Archimedes is most famous for the Archimedes Principle which explains how to measure the volume of an irregular object.

Archimedes discovered his principle quite by accident. He noticed that the water level of the bathtub rose when he got in, and he realised that you could measure volume by putting it on water, and measuring how much the water level rose. Supposedly, the scientist got so excited by this discovery that he ran through the streets naked, yelling 'Eureka!' which is Greek for 'I figured it out!'



ERATOSTHENES

What is Eratosthenes famous for?

Eratosthenes was an Ancient Greek scientist born in the town of Cyrene, which is now in Libya, in about 276 BC. He was famous as a mathematician and geographer.

Eratosthenes produced a reliable, logical method to discover prime numbers. It's known as the sieve of Eratosthenes, and is still important in modern number theory in an updated form.

Assuming that the Earth was a sphere, Eratosthenes calculated its size with good accuracy. He also calculated the tilt of Earth's axis fairly accurately. Eratosthenes produced the first map of the world which used meridian lines and parallel lines. These were similar to our modern lines of latitude and longitude. This great scientist can be said to have invented geography.

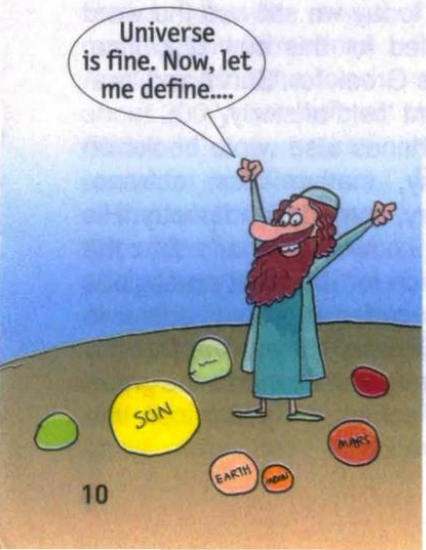
In fact, today we still use the word he invented for this new discipline. 'Geo' was Greek for 'Earth' and 'graphy' meant 'field of study.'

Eratosthenes also wrote books on philosophy, mathematics, astronomy, history, comedy, and poetry. His all-round knowledge made him the ideal choice for the most prestigious job an academic could enjoy in Ancient Greece. He was the Director of the Library of Alexandria, the greatest intellectual institution of the ancient world.

PTOLEMY

What are the contributions of Ptolemy?

Ptolemy was a Greek astronomer, astrologer, mathematician and geographer who lived and worked in Alexandria in Ancient Egypt, in the second century AD.



His work 'Almagest,' is one of the most important works in ancient astronomy. It covers the motion of Sun, Moon, and the planets around the Earth. It also contains a catalogue of stars with their brightness on a logarithmic scale.

Ptolemy's description of the Universe was accepted by the astronomical community for more than a thousand years. Ptolemy's second important work is called 'Geography.' It is a thorough discussion of the geographic knowledge of the Greco-Roman world.

Ptolemy's treatise on astrology was influential because of its practical treatment of astrology. Ptolemy discarded practices that did not have a logical basis, and also believed that astrology was not a completely reliable science.

GALEN

Why are Galen's contributions to medicine important?

Galen was a Greek who became the Ancient Roman Empire's greatest physician. He had great expertise in anatomy, surgery, pharmacology and therapeutic methods.

Galen had an absolute belief in the power of experiment and observation. He did not believe in merely following what books told him was true. He needed to verify the truth for himself.

His anatomical reports, based mainly on dissection of monkeys, remained uncontested until 1543, when printed descriptions and illustrations of human dissections were published.

Galen, the great scientist, consolidated the work of previous Greek medical researchers, adding the results of his own research, to create an incredibly long-lasting medical doctrine. This medical doctrine dominated the Western world for 1500 years.

AMAZING

Unknown Earth

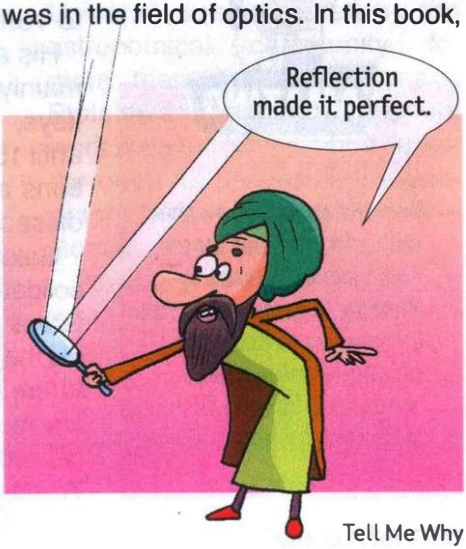
Very little was known about the Earth in earlier times. Columbus used maps by Ptolemy to guide him during his voyages to find a route to India by sailing westwards from Europe. These maps were not very accurate.

ALHAZEN

Why is Alhazen known as the pioneer of modern optics?

Born in the tenth century AD, Alhazen was an Arab who was known as the first true scientist. He developed the scientific method of experimentation, and was the first person to formulate hypothesis and conduct verifiable experiments. A scientist, philosopher, astronomer, and mathematician, Alhazen wrote over a hundred books, more than half of which have been preserved.

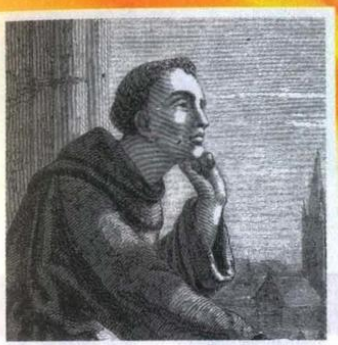
One of his most influential writings was in the field of optics. In this book,



STAR FACT

Translations

In the 16th century, Galen's original Greek texts were translated into Latin by another legendary physician, Andreas Vesalius.



ROGER BACON

Alhazen gave experimental proof of the nature of light, the structure of the eye and the basic principles of reflection via mirror. He stated that contrary to popular belief, the eye does not send out rays to the object it sees. Rather it is the light reflected via the object that the eye beholds.

This was a completely new and revolutionary concept. The book comprises seven volumes, and was translated into Latin.

Why was Roger Bacon called Doctor Mirabilis?

Roger Bacon was an English philosopher and Franciscan monk who promoted experimental science and was deeply interested in the study of nature.

He studied mathematics, astronomy, optics, alchemy and languages. His studies on the nature of light, and on rainbows, are especially noteworthy, and he seems to have planned and interpreted these experiments carefully.

He seriously studied the problem of flying in a machine with flapping wings. He was also the first person in the West to give exact directions for making gunpowder.

Roger Bacon's work was talked about everywhere, and eventually won him a place in popular literature as a kind of wonder worker. He was also called Doctor Mirabilis- 'mirabilis' in Latin means 'wonderful teacher.'

COPERNICUS

Why is Nicolaus Copernicus considered to be a key figure in the field of astronomy?

Nicolaus Copernicus was a 15th century astronomer, mathematician, translator, artist, and physicist, among other things.

He is best known as the first astronomer to put forward the idea of a system in which the planets and planetary objects orbit the Sun.

By 1508, Copernicus had begun to create his model of the planetary system, suggesting that the Sun, and not our Earth, was the centre of the Universe. His model of the Universe was accepted, whereas earlier models had not been, because his was more detailed and accurate. He also had a better formula for the calculation of the positions of the planets at different times of the year.

The Roman Catholic Church criticised Copernicus' theories. It went so far as to ban his book 'De

PARACELSUS

Revolutionibus Orbium Coelestium,' after he died, and it remained a forbidden book for almost three hundred years.

The ideas of Copernicus were instrumental in the evolution of the field of astronomy. In fact, almost every notable astronomer who came after him was influenced by his theories.

Who was Paracelsus?

Paracelsus was a renowned German physicist, and botanist of Swiss origin. His path breaking findings in botany and medicine made him a pioneer in his field.

Paracelsus became a notable physician in the early 16th century. He rejected most of the prevalent and widely accepted world views, and magic theories of medicine. While working on medicines, Paracelsus brought together the use of chemicals in medicines. In 1526, he coined the term 'zincum' for the chemical element zinc. He is also known for discovering 'laudanum' which is an alcoholic herbal preparation.

Paracelsus was a strict follower, and a firm believer of the classical Greek concept of elements. However, he added his own findings to this concept. Paracelsus' real name was Philippus von Hohenheim.

The name 'Paracelsus' was actually a nickname. It means 'equal to or greater than Celsus' and refers to his medical skill.

VESALIUS

Not Hollow

It was Andreas Vesalius who first concluded that nerves are not hollow.

Why does the work of Andreas Vesalius represent a milestone in medicine?

Andreas Vesalius was the founder of modern anatomy. This 16th century physician and surgeon completely revolutionised the science of biology and medicine.

By careful and painstaking dissections of cadavers, he learned a great deal about the structure of the human body and laid the foundation for modern physiology.

In 1543, he published a remarkable book 'De humani corporis fabrica'. It was a fully illustrated anatomy of the human body, based on the observations Vesalius had made during his dissections. The book destroyed the misconcep-

TYCHO BRAHE

tions in anatomy that had persisted for over a thousand years.

Vesalius' anatomical studies corrected many religious beliefs and the finding of a previous physician Galen, who had dissected apes because religion forbade him to dissect real human cadavers.

Vesalius was the first surgeon to actually cut open a cadaver or dead body of a human being, and his exceptionally detailed muscle drawings changed medical history for all time.

Who was Tycho Brahe?

Tycho Brahe was a famous Danish astronomer who played a vital role in the development of various astronomical instruments.

He devised his own instrument, even before the invention of the telescope, to observe the heavens. These instruments allowed Brahe to determine the movements of heavenly objects more precisely.

Brahe made significant contributions in the study of the Moon and the planet Mars, which would later prove extremely useful to other astronomers. Instruments built by Brahe proved to be very helpful in accurate determinations of latitude and longitude.

Brahe built his first observatory at Herrevad Abbey in 1572, and another one named 'Uraniborg' in 1576. He also built a third one called 'Stjerneborg' in 1581.

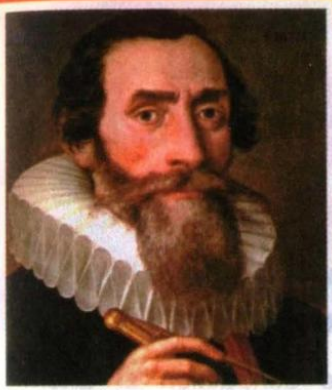
GALILEO

What makes Galileo Galilei a remarkable scientist?

Galileo Galilei was a groundbreaking Italian astronomer, physicist, mathematician, philosopher and inventor. He opened the eyes of the world to a new way of thinking about how the solar system works.

For many years, scientists had believed that the solar system revolved around the Earth, and that the Earth was the centre of the Universe.

Galileo was the first scientist to prove that this wasn't correct. He stated that in fact, the solar system revolved around the Sun. He also invented an improved telescope so that he could gaze far into space. He was the first to see Jupiter's moons, and the first to realise that our Moon was covered with craters. Besides inventing the improved telescopes, he also invented the compass and a thermometer. Galileo has played a major role in the scientific revolution of the 17th century.



KEPLER

Why is Johannes Kepler considered one of the leaders of the scientific revolution?

Johannes Kepler was a leading astronomer of the Scientific Revolution. The Scientific Revolution is the term used to describe the emergence of modern science that took place throughout the 16th and 17th centuries.

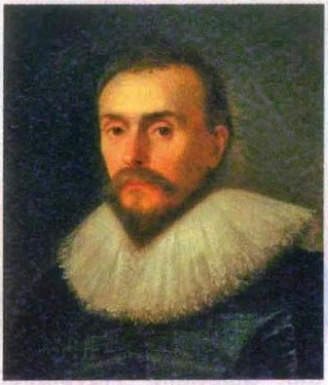
Before the Scientific Revolution, astronomy was closely tied to astrology, which is the belief that the movement of the stars and planets can be interpreted to predict the future.

As the Scientific Revolution progressed, astrology increasingly came to be replaced by astronomy as a modern, legitimate science. Johannes Kepler is best known for his discovery that the orbits in which the Earth and the other planets of the solar system travel around the Sun are elliptical, or oval, in shape.

He was also the first to explain correctly how human beings see, and demonstrated what happens to light when it enters a telescope.

In addition, he designed an instrument that serves as the basis of the modern refractive telescope.

Since he was such a prominent figure in the field of astronomy, a lot of spots on distant planets have been named after him such as 'Kepler's Crater on Mars' and 'The Kepler Crater,' on the Moon.



WILLIAM HARVEY

Why is William Harvey's work a milestone in medicine?

William Harvey was an English physician who lived in the 17th century. He was the first person to correctly describe blood's circulation in the body.

He showed that arteries and veins form a complete circuit and that this circuit starts at the heart, and leads back to the heart. He also established that the heart's regular contractions drive the flow of blood around the whole body.

Before his discoveries, blood was thought to ebb and flow through the body by the contraction of arteries. Harvey's knowledge came from observations he made of blood flowing through the veins and arteries of living animals that he cut open. This may seem cruel, as there were no anaesthetics in Harvey's time.

BLAISE PASCAL

Nevertheless, it is how we arrived at an understanding of blood and its circulation in the body.

William Harvey's work also laid down the foundations of physiology, which is the study of body functions.

What is the importance of Blaise Pascal's work?

Blaise Pascal was a 17th century French philosopher and scientist who made important contributions to maths, science, and philosophy. While he was still a teenager, Pascal became one of only two people who had developed and constructed a working mechanical calculator.

As a mathematician, Pascal developed two separate fields of maths - projective geometry, and probability theory. This probability theory was born out of Pascal's study of gambling problems, and had an important impact on the development of modern day economics.

In projective geometry, he developed what became known as Pascal's triangle, in which the sums of successive numbers built on themselves to form the numerical row beneath.

Pascal's scientific theories were important to understanding the properties and volume of solids using cycloids. Pascal was also an expert in various languages, and a well-versed religious philosopher.

ROBERT BOYLE

Why is Robert Boyle referred to as a founder of modern Chemistry?

Robert Boyle was a famous Anglo Irish scientist who transformed chemistry in the 17th century. Till then, chemistry was confined to alchemy and mysticism.

Alchemy was the study of how to change basic substances such as metals into other more valuable substances. Boyle made chemistry a science based on measurement.

He defined elements, compounds and mixtures and he coined the new term 'chemical analysis,' a field in which he made

TORRICELLI

Evangelista Torricelli was the inventor of the barometer. He was an Italian mathematician, best known for his contributions to optics.

several contributions. Robert Boyle is most famous for Boyle's Law. It was the first of the gas laws linking the pressure of a gas to its volume. He established that electrical forces are transmitted through a vacuum, but sound is not.

Boyle also stated that the movement of particles is responsible for heat. He was the first person to write specific experimental guidance for other scientists, telling them the importance of achieving reliable results. He was indeed a 'mighty chemist'.

Robert Boyle is regarded as the first modern chemist, and is referred to as one of the founders of modern chemistry.

MARCELLO MALPIGHI

Who was Marcello Malpighi?

Marcello Malpighi was an Italian biologist and physician who had a wide knowledge of both plants and animals, and made contributions to the scientific study of both.

He founded the sciences of microscopic anatomy and histology. He studied animal tissues extensively for 40 years, using microscopes that he had made himself.

Malpighi was the first person to see capillaries in animals. He discovered the link between arteries and veins that had eluded William Harvey.

Malpighi was also the earliest person to observe red blood cells under a microscope. He is noted for his studies on the structure of glands.

In his treatise De polypo cordis published in 1666, Malpighi explained blood composition, as well as how blood clots are formed. His research provided a foundation for later advances in physiology, embryology, and practical medicine.

HUYGENS

Why is Christiaan Huygens considered a leading scientist of his time?

Christiaan Huygens, a Dutch philosopher and mathematician, was one of the leading scientists in the 17th century. He started by trying to disprove theories that had been established by Ancient Greeks in geometry.

He was interested in telescopes and astronomy, and spent a lot of time designing methods to improve the mechanical and optic performance of telescopes.

In his book entitled 'Systema Saturnium' published in 1659, he noted the discovery of the rings around the planet Saturn, and made observations about the planets, the Moon, and Orion Nebula. His keen interest in the field of astronomy led him to measure time and other matters that relate to mechanical physics.

One of his most important contributions was that he explained the vital principles of classical physics like centripetal force and gravity in a vacuum in another book of his.

LEEUWENHOEK

Huygens also put forward a theory explaining the wave behaviour of light. His reputation as a scientist and a scholar became known worldwide, and remains so to this day.

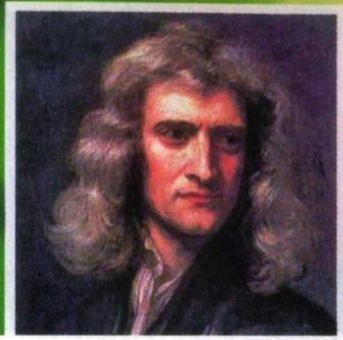
Why is Antonie van Leeuwenhoek called 'father of microbiology'?

Antonie van Leeuwenhoek was a 17th century Dutch scientist. He is best known for discovering protozoa, and creating more than 500 simple microscopes.

Van Leeuwenhoek was the first scientist to closely observe cells under a microscope. One of his most groundbreaking discoveries was also one of his first. His observations, in 1674, of scummy pond water, led to the first visual descriptions and illustrations of such common organisms as the algae spirogyra. This contributed towards the foundation of several branches of biology.

He made one of the first recorded observations of bacteria when he studied the plaque from his teeth. He noticed what he called 'animalcules' in the saliva sample. These animalcules were actually bacteria. He gave cells their name because he thought they resembled the shape of a monk's quarters.

Although Van Leeuwenhoek never received any formal scientific training, he is considered to be the father of microbiology for his contributions to that field of science.



ISAAC NEWTON

Weird

A weird fact about Newton is that in spite of being so scientifically minded, he believed in the existence of the 'philosopher's stone'. This was a legendary substance, allegedly capable of turning inexpensive metals into gold. Newton's great ambition was to find it!

What makes Sir Isaac Newton a legendary figure?

Sir Isaac Newton, an Englishman who lived in the 17th century, is a scientific legend. He came up with numerous theories and contributed ideas to many different fields including physics, mathematics, and philosophy.

In 1687, Newton published his book Philosophiae Naturalis Principia Mathematica. In it, he describes universal gravitation, and the three laws of motion. It is widely regarded to be one of the most important books in the history of science. It is well known that his work on formulating a theory of gravitation was inspired by watching an apple fall from a tree!

During his lifetime, Newton developed a new type of mathe-

HALLEY

matics called calculus, and made breakthroughs in the area of optics such as the reflecting telescope. He also discovered that white light is made up of a wide range of different colours.

Newton was a deep thinker with an insatiable curiosity to know everything about everything he saw. His contributions are so numerous, that he changed forever the way in which we look at the world.

What is Halley's Comet?

Edmond Halley was an English scientist who became very interested in a comet that he saw in 1682. After being told that a similar comet had appeared in 1531 and 1607, he suspected that it was the same comet that he had seen.

By using the laws of gravity discovered by his friend Sir Isaac Newton, Halley realized that he could predict when it would return. Halley worked out that the comet would appear in our skies every 75 to 76 years.

He was correct in his prediction, but sadly when the comet did reappear, he was no more, and he could not witness the confirmation he had waited for so eagerly. In his honour, the comet was named after him.

Though he is remembered foremost as an astronomer, Halley also made significant discoveries in the fields of geography, mathematics, meteorology, and physics. Halley was very close to Newton.

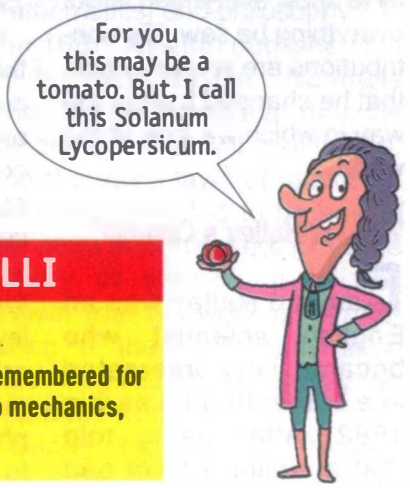
CARL LINNAEUS

Why is Carl Linnaeus one of the giants of natural science?

In the 18th century, the Swedish naturalist and physician Carl Linnaeus introduced the scientific system of classifying plants and animals that is used all over the world to this day.

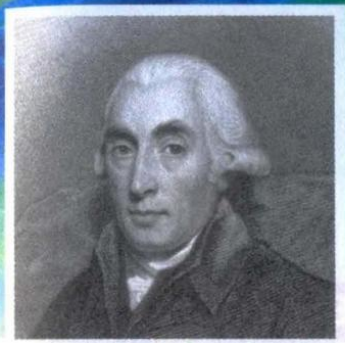
Under this system, each living thing is assigned a name consisting of two Latin words. The first word is the name of the genus, and the second, the species. The classification of living things is called taxonomy.

In 1737, Linnaeus published the first edition of his book titled Systema Naturae or System of Nature. Over the years, Linnaeus continued to develop his ideas



DANIEL BERNOULLI

Daniel Bernoulli was a renowned mathematician. He is especially remembered for his applications of mathematics to mechanics, especially fluid mechanics.



JOSEPH BLACK

and add new species so that the book grew in a period of about 30 years from 12 outsize pages in its first edition, to 2400 pages in its twelfth edition.

This was the first serious attempt ever made to document all of our planet's species. It was a huge effort, and it won Linnaeus acclaim as the 'Father of Taxonomy'.

Why is Joseph Black famous?

Joseph Black, a British chemist and physicist, is famous for his discovery of carbon dioxide. Black was always a meticulous chemist, keeping careful note of all his results and measurements. It was this which led to his discovery of carbon dioxide.

Black also took an interest in the science of heat. In the 18th century, there were several competing theories about the nature of heat, and how it related to temperature.

Black's investigations not only clarified the distinction between temperature and heat, but also resulted in the theory of latent heat. Black was a gifted and effective teacher. His course in chemistry proved so popular that many students, even those with no particular interest in the subject, were eager to attend.

Alongside his teaching, Black carried on an active and demanding medical practice. Joseph Black, widely respected both as a scientist and a physician, is truly one of the titans in the world of science.

HENRY CAVENDISH

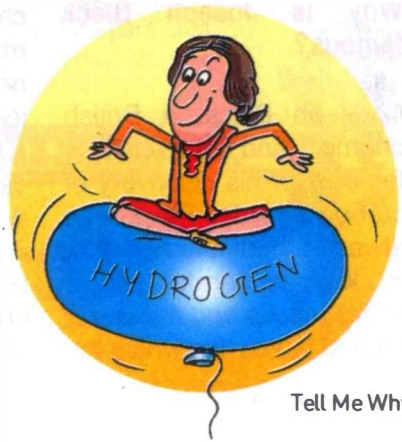
What was Henry Cavendish renowned for?

The English scientist Henry Cavendish was an experimental chemist and physicist par excellence. Cavendish was the first to recognise hydrogen gas as a distinct substance. He called it inflammable air.

Cavendish showed that hydrogen is much less dense than air. In 1785, he published a paper showing the Earth's atmosphere consists of four parts nitrogen to one part oxygen.

In addition, to his achievements in chemistry, Cavendish is also known for the Cavendish experiment. He was the first to measure the force of gravity between masses in a laboratory, and to produce an accurate value for Earth's density.

Henry Cavendish also experimented with electricity, but much of his work on the subject was only published after his death. He was renowned for the great accuracy and precision of his scientific research.



JOSEPH PRIESTLEY

Why was Joseph Priestley a remarkable scientist?

Joseph Priestly, an Englishman is noted for his groundbreaking contributions to experimental chemistry, electricity, and the chemistry of gases.

Before him, scientists thought that the air on Earth consisted of carbon dioxide and hydrogen. Priestley brought 10 more gases to this list, such as nitrogen, hydrogen chloride, carbon monoxide, nitrous oxide and oxygen.

He isolated oxygen in its gaseous state, and conducted a series of experiments to distinguish each gas based on its properties. Priestley also made another discovery that has been highly appreciated by surgeons worldwide. He discovered nitrous oxide, which was also known as laughing gas. It was the first surgical anaesthetic to be used.

Priestley's best known achievement in the field of biology in 1772 was his work with photosynthesis. Priestley's other interesting discoveries include the fact that graphite is a good electric conductor, and that gummy tree sap is a good eraser for pencil marks.

Did you know that you can enjoy your favourite fizzy drink thanks to Joseph Priestley, for he was the one who invented soda water?

WILLIAM HERSCHEL

Why is William Herschel considered a great astronomer?

William Herschel was a German-born British scientist who became one of the most important astronomers of the 18th century. He built his own telescopes.

From the garden of his house, William Herschel noted 'every star in the heavens' through a telescope that he had constructed himself.

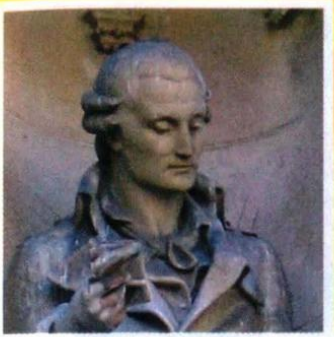
He also manufactured over 400 telescopes that were in great demand worldwide. His study of the heavens led him to the discovery of a planet that would eventually be called Uranus. William Herschel would also discover Titania and Oberon, which were the moons of Uranus as well as Enceladus and Mimas, the moons of Saturn.

Herschel maintained that the solar system is moving through space, and found out the direction of that movement. He also suggested that the Milky Way was in the shape of a disc. Herschel is considered to be the founder of modern stellar astronomy.

William Herschel, a great scientist was a gifted musician too. He played the oboe, violin, harpsichord and organ.

ANDERS CELSIUS

Anders Celsius, a Swedish astronomer, is best remembered for the Celsius temperature scale, which was developed by him in 1742.



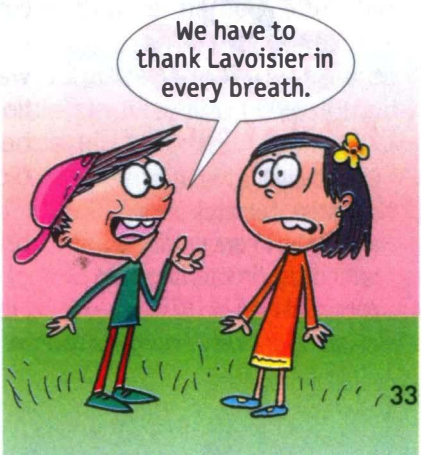
ANTOINE LAVOISIER

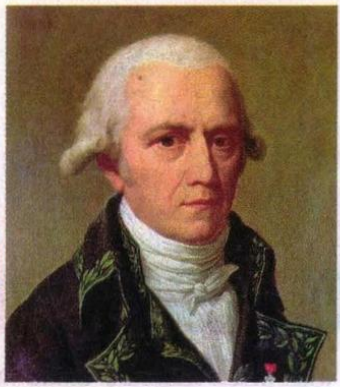
How did Antoine Lavoisier revolutionise chemistry?

Antoine Lavoisier revolutionised chemistry. It was he who coined the name oxygen for the element released by mercury oxide.

He found that oxygen made up 20 per cent of air, and was vital for combustion and respiration. He also concluded that when phosphorus or sulfur is burned in air, the products are formed by the reaction of these elements with oxygen.

The elements carbon and hydrogen were also named by him. Another milestone was when Lavoisier correctly identified sulfur as an element. A year later, he found that when mercury oxide is heated, its weight decreases. The oxygen it releases has exactly the same weight as the weight lost by the mercury oxide. After carrying out further experiments, Lavoisier announced a new fundamental law of nature- the law of conservation of mass. This law states that the total mass of a chemical reaction's products is identical to the total mass of the starting materials.





LAMARCK

What do we know about Jean Baptiste Lamarck?

Jean Baptiste Lamarck was one of the pioneers in the field of biology.

In fact, the very name 'biology' was coined by this French naturalist. He is best remembered for his theory of evolution. According to this theory, the characteristics an organism develops during its lifetime in response to its environment are inherited by, or passed on to, its offspring.

Lamarck was the first to use the term invertebrate to describe animals without backbones. He began collecting fossils and studying all sorts of simple species.

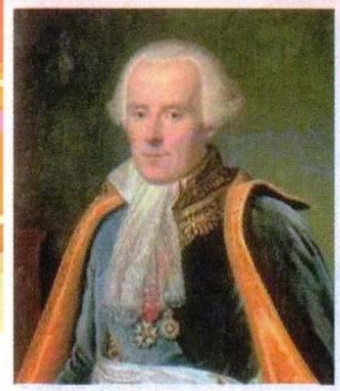
As a result of these studies, he was able to revise the classification of lower animals that had been unfinished by the Swedish biologist Linnaeus.

Lamarck's study of invertebrates also led to the publication of his major work 'The Natural History of Invertebrate Animals' in 1815–22.

STAR FACT

Pathetic Figure

Even though a great scientist, Lamarck became a pathetic figure during his later days. He was blind and poor, and died in 1829.



PIERRE LAPLACE

Why is Pierre-Simon Laplace always remembered?

Pierre-Simon Laplace was a French physicist and astronomer of the 19th century. He had a phenomenal natural mathematical faculty, and predicted many things, using only maths.

These predictions were later confirmed with powerful telescopes. He wrote a book explaining his theory of the origin of the solar system.

Laplace presented a steady stream of remarkable mathematical papers that spread his fame. Pierre-Simon Laplace is highly regarded for his influential, five-volume treatise which developed a strong mathematical understanding of the motion of the heavenly bodies. This work interpreted the geometric study of classical mechanics, starting up a wider range of problems.

Laplace's work, and the results he produced, made him one of the most important and influential scientists that the world has seen. The Laplacian differential operator that is named after him is widely used in mathematics.

Laplace won many awards for his studies, and he was made a marquis, but he remained modest, saying, "What we know is little. What we know not is immense."

His work regarding the theory of probability and statistics is considered pioneering.

EDWARD JENNER

Why is Edward Jenner assured of a place in history?

Edward Jenner, a doctor in England, lived during the 18th century.

At that time, smallpox was a dreaded disease that killed thousands of people every year. Smallpox is an infectious disease which causes pus-filled blisters to spread over the body, and often resulted in death.

Jenner noticed that milkmaids were immune to smallpox. He thought that this was because they were often infected by cowpox, a disease similar to smallpox, but less severe.

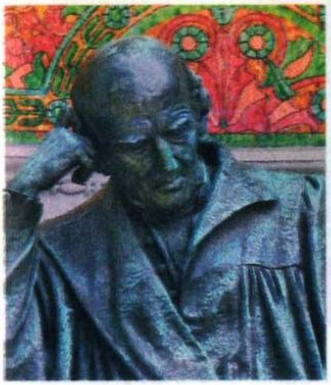
Jenner believed that the pus from blisters caused by cowpox protected the milkmaids from smallpox. He tested the theory by inoculating a boy called James Phipps, his gardener's son, with pus from cowpox blisters. James experienced a fever, but he did not get smallpox.

Jenner repeated the experiment on more than 20 people, proving that those he had inoculated with cowpox, were immune to smallpox.

Edward Jenner thus became the pioneer of the world's first vaccine- the smallpox vaccine. His work on smallpox made him internationally famous.

Today, smallpox has been completely eradicated from the world, thanks to the smallpox vaccine, and Edward Jenner.

SAMUEL HAHNEMANN



Why is Samuel Hahnemann famous?

Samuel Hahnemann, a German physician, founded homeopathy.

Hahnemann believed that the medicine he had been taught to practice sometimes did the patient more harm than good.

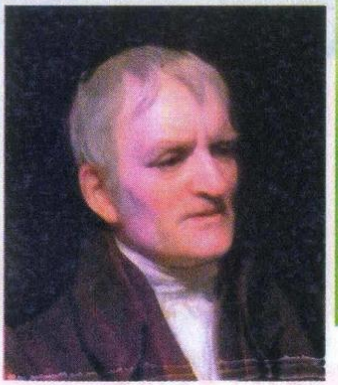
He carried out experiments on the curative power of bark, which was the source of quinine. He was the first person to observe that a remedy that produces symptoms in a healthy person will cure those same symptoms when manifested by a person in a disease state.

STAR FACT

A Scary Experiment

Hahnemann conducted a rather scary experiment on himself. At a time when he was perfectly healthy, he brought on the symptoms of a malaria attack by giving himself repeated doses of quinine, which is usually used to treat malaria.

This principle that 'likes are cured by likes' is the very foundation of homeopathy. Hahnemann is called the 'father of experimental pharmacology' because he was the first physician to prepare medicines in a specialised way, by first trying them on healthy human beings, to determine how the medicines acted to cure diseases.



JOHN DALTON

What do we know about John Dalton?

John Dalton, a British scientist, is probably best known for his groundbreaking research and contributions to two completely different fields- atomic theory and colourblindness.

It was discovered in 1995 that Dalton actually had a very rare form of colourblindness- he was only able to see one colour, yellow.

So, he studied the problem in great detail and concluded that colourblindness was a genetic feature, as his brother was also colourblind.

Dalton was also very influential in the study of meteorology, specifically barometric pressure. This led to his publication of a series of papers called Experimental Essays in which he discussed the makeup of mixed gases.

The most important of all Dalton's investigations are those concerned with the atomic theory in chemistry. The research had a great impact on atomic theory. He created a listing of atomic weights for six different elements - hydrogen, oxygen, nitrogen, carbon, sulfur, and phosphorous.

Dalton's interpretation of atomic theory maintained that atoms are combined in chemical reactions, but also that they can be separated and rearranged. Without doubt, it was John Dalton's atomic theory that laid the foundations of modern chemistry.

ANDRE-MARIE AMPERE

Why is Andre-Marie Ampere considered a scientific genius?

Andre-Marie Ampere was a French physicist and mathematician, who made the revolutionary discovery that a wire carrying electric current can attract or repel another wire next to it, that's also carrying electric current. The attraction is magnetic, but no magnets are necessary for the effect to be seen.

Ampere went on to formulate Ampere's Law of electromagnetism and produced the best definition of electric current of his time. He also proposed the existence of a particle we now recognise as the electron, discovered the chemical element fluorine, and grouped elements by their properties.

In recognition of Ampere's contribution to modern electrical science, the 'ampere' was established as a standard unit of electrical measurement, in 1881, forty-five years after his death.

Polymath

A person of great learning in different fields of study is known as a polymath. Andre-Marie Ampere was a polymath for he was well versed in history, poetry, philosophy, and the natural sciences.

AVOGADRO

New Experiment

Although Robert Boyle's chief scientific interest was chemistry, his first published scientific work in 1660 was 'New Experiments Physico-Mechanicall, Touching the Spring of the Air, and Its Effects'.

What were Amedeo Carlo Avogadro's contributions to physics?

Amedeo Avogadro was an outstanding Italian physicist who lived in the 18th century.

Although he had followed the family tradition by studying law, he gradually lost interest in legal matters. He found science was much more intellectually stimulating.

Mathematics, and physics, in particular attracted his logical mind. Avogadro is chiefly remembered for his molecular hypothesis, first presented in 1811. He stated that equal volumes of different gases contain an equal number of molecules, provided they are at the same temperature and pressure.

Amedeo Avogadro was a great scientist who made important contributions to physics. However, he never received any awards for his discoveries.

Avogadro's hypothesis gained acceptance only after his death as people did not recognise their significance.In honour of his contributions to molecular theory, the number of molecules in one mole was named Avogadro's number.

JOHANN GAUSS

Why is Johann Gauss considered to be a mathematical genius?

Johann Gauss was a German mathematician who had a remarkable influence in many fields.

These included the number theory, statistics, analysis, differential geometry, electrostatics, astronomy and optics.

Gauss systematised the study of number theory and was fundamental in consolidating it as an important discipline. Gauss also discovered Ceres, the largest of the asteroids orbiting the Sun. His Theory of Celestial Movement remains a cornerstone of astronomical computation to this day. Among many other achievements, Gauss is responsible for a procedure used currently in all sciences to minimize the impact of measurement error.

He kept a diary of his discoveries, listing 146 discoveries, which was lost for over 40 years after his death. Gauss is deservedly ranked as one of history's most influential mathematicians.

Why is Humphrey Davy regarded as one of the luminaries of the scientific world?

Sir Humphrey Davy was an English chemist who made many notable contributions to science, especially in electrochemistry. He is renowned for the invention, in 1815, of the Davy safety lamp

HUMPHREY DAVY

An Accident

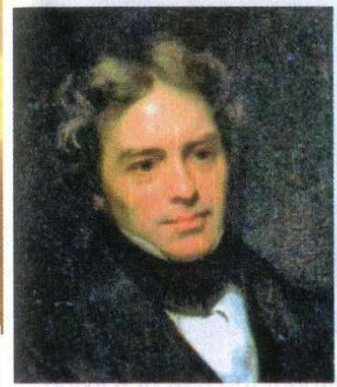
An accident with nitrogen trichloride damaged Humphrey Davy's eyes while he was working in the lab. So he depended a lot on the help he got from a colleague, Michael Faraday.

that helped to prevent explosions in coal mines. Davy was the first to isolate several chemical elements, including sodium and potassium.

He discovered boron, and found that nitrous oxide, or laughing gas, had anaesthetic properties that could be useful in surgery. Davy did many experiments on the effects of breathing in certain gases- and once, almost killed himself by inhaling a mixture of toxic gases.

His research included work on early forms of electric batteries, and the use of electricity to isolate chemical elements. He also analyzed minerals, and completed many studies in tanning and agricultural chemistry.

Did you know that in 1809, Humphrey Davy invented the very first electric light? He did this by connecting two wires to a single battery, and then attaching a charcoal strip between the other two ends of the wires. The charged carbon then glowed, making the very first arc lamp. Humphrey Davy was one of the greatest scientists, ever in the history of mankind .



MICHAEL FARADAY

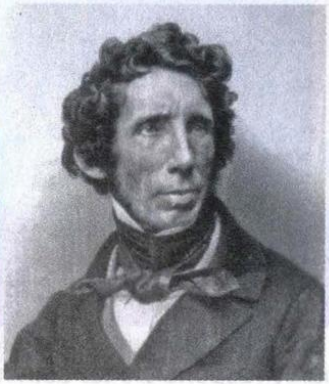
Why is Michael Faraday known as the 'father of electricity'?

Michael Faraday was a 19th century British chemist and physicist. He is often called the father of electricity with good reason.

His work on electrochemistry and electromagnetism laid the foundation for many areas of science. It was in 1831 that Faraday discovered electromagnetic induction, the principle behind the electric transformer and generator. This discovery was crucial in allowing electricity to be transformed from a curiosity, into a powerful new technology. He was partly responsible for coining many familiar words including 'electrode', 'cathode' and 'ion'. Faraday laid the basis of the electromagnetic field concept in physics, discovered the laws of electrolysis, and invented electromagnetic rotary devices that were vital in the creation of electric motors. Faraday has thus played a key role in the development of electricity for use in modern technology.

GEORG SIMON OHM

Georg Simon Ohm was a German physicist and mathematician. He was born on 16th March, 1789. Ohm's Law, which shows the relationship between voltage and current, was discovered by him.



FRIEDRICH WOHLER

Why is Friedrich Wohler one of the luminaries of the scientific world?

Friedrich Wohler was a German chemist who chose to be a teacher of chemistry. He was one of the finest scientists of the 19th century.

Wohler gained international renown from two path breaking discoveries. In 1827, Wohler prepared the first pure sample of aluminium. This metal is the third most prevalent element in the Earth's crust, but it is exceedingly difficult to isolate it from its compounds.

He also discovered how to make urea in the laboratory without the use of a living kidney. This was an important discovery, because it heralded the end of an existing theory that organic compounds could only be made by living things. Wohler was the co-discoverer of beryllium, silicon, and silicon nitride.

In 1832, Wohler, along with another scientist Justus Liebig published a study on the oil of bitter almonds which proved that a group of atoms can act like a single element, and be exchanged for elements in chemical compounds. This too, took the scientific world by storm.

What do we know about Justus Liebig?

Justus Liebig is considered to be the founder of organic chemistry. Liebig was one of the first

JUSTUS LIEBIG

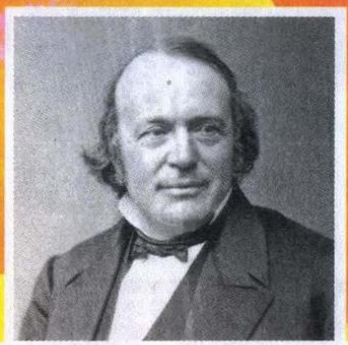
chemists to organise a modern laboratory that became the model for teaching practical chemistry. Liebig developed an instrument for determining the carbon, hydrogen, and oxygen content of organic materials. In 1832, he and Friedrich Wohler published their study of the oil of bitter almonds which proved that a single compound can behave like an element in a chemical reaction. This became the foundation of the theory of compound radicals.

Father of Fertilizer Industry

Liebig established that nitrogen is an important plant nutrient. So, he is sometimes referred to as the 'father of fertilizer industry.'

Liebig advanced the idea that chemistry could revolutionise farming and greatly increase yields in a book that he wrote. In this book, he discussed plant nutrition, and chemical transformations in plants and animals.

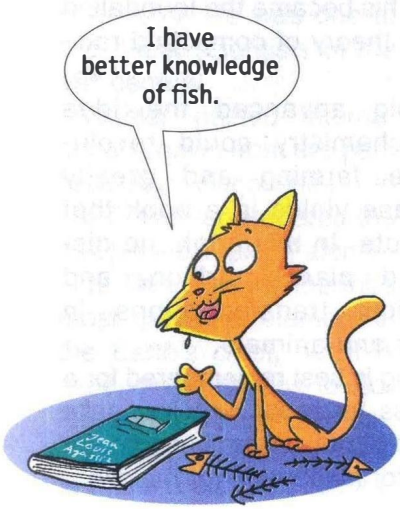
Liebig is best remembered for a process for reducing silver salts to metallic silver that became the basis for modern mirror making.



LOUIS AGASSIZ

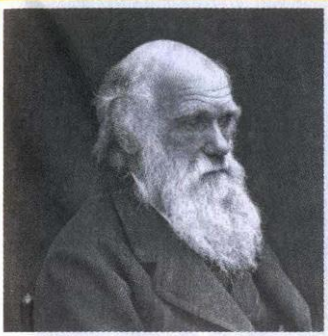
Who was Jean Louis Agassiz?

Jean Louis Agassiz, a Swiss-American naturalist, was an outstanding comparative anatomist. When he was only 21 years old, he published the work that launched him on his long and distinguished scientific career. It was titled 'The Fishes of Brazil' and it was the most important account of a local fish fauna published till that time.



Later, Agassiz worked under Georges Cuvier, another brilliant comparative anatomist. Agassiz made extensive contributions to ichthyological classification, including of extinct species.

Ichthyology is the branch of biology devoted to the study of fish. Agassiz also played an important role in the study of geological history including the founding of glaciology. He was a person with many interests- a biologist, physician, geologist, teacher, and most importantly, a prominent innovator in the field of the study of natural sciences.



CHARLES DARWIN

Why is Charles Darwin one of the most influential scientists in history?

Charles Darwin was an English naturalist who is best known for his ideas on evolution. In 1831, Darwin set sail on the HMS Beagle, a naval survey ship. Darwin's job was to collect plant and animal specimens from the countries the ship visited. The voyage took five years.

For Charles Darwin, the most important part of the journey was the time spent in the Galapagos Islands which are the home to plants and animals that can't be found anywhere else in the world.

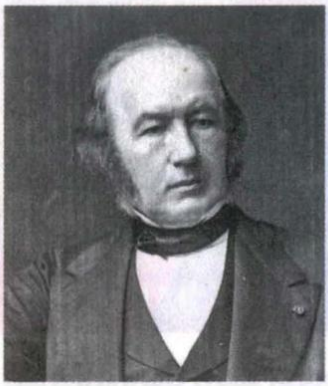
On his return to England, Darwin started to piece together his theory of natural selection which explains how populations evolve. In 1859, Charles Darwin published his book 'On the Origin of Species'.

According to this theory, all species of life have evolved over time from common ancestors. Charles Darwin changed the way humans viewed themselves.

STAR FACT

Most Influential

Darwin has been described as one of the most influential thinkers of all time. He was the first to make people aware of their place in the evolutionary process. Darwin is buried in Westminster Abbey.



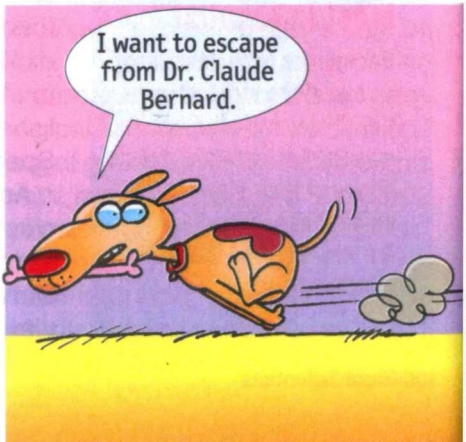
CLAUDE BERNARD

Why is Claude Bernard called one of the greatest of all men of science?

Claude Bernard, a French physiologist, has been called one of the greatest of all men of science. Bernard was fascinated with the mechanics of digestion.

He made a number of experiments in which he made openings into the stomachs of live animals in order to study their workings. His experiments resulted in a number of important discoveries, including the finding that the small intestine played a key role in the digestive process.

His experimentation also helped show the significance of the pancreas. In 1857, Bernard discovered glycogen, the large molecule found in animals' livers which acts as a reserve store of carbohydrates, and helps to regulate blood sugar. Bernard also studied the nervous system. While engaged in this research, Bernard made the important discovery that oxygen was carried around the body by



LUDWIG HELMHOLTZ

the red corpuscles in an animal's blood.

Bernard was one of the founders of experimental medicine, and played a vital role in laying down the basic rules of experimentation in the life sciences.

What were Hermann Ludwig Helmholtz's contributions to science?

Hermann Ludwig Helmholtz, a German physician and physicist, is best known for the law of the conservation of energy. He also made significant contributions to physiology, optics, electrodynamics, mathematics, and meteorology.

In 1847, he published his paper 'On the Conservation of Force'. This was the first explanation of the fundamental concept of conservation of energy. His inventions of the ophthalmoscope allowed physicians to see inside the eye, and revolutionized the field of ophthalmology.

Helmholtz was a keen mathematician, and in 1858 published the paper which provided a key to the fundamental structure of matter. He also investigated the physics of tone and colour perception. But above all, it is his theory of the conservation of energy that is his greatest contribution, for it is one of the broadest and most important generalizations ever known in the history of science.

JAMES JOULE

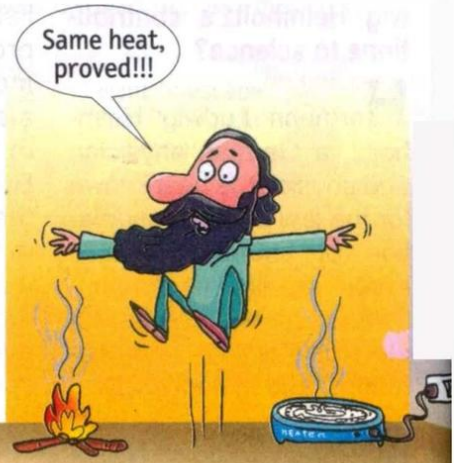
Why was James Joule an extraordinary scientist?

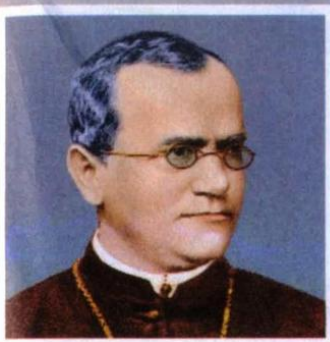
The English physicist James Joule studied the nature of heat, and established its relationship to mechanical work.

He showed that the various forms of energy—mechanical, electrical, and heat—are basically the same, and can be changed, one into another. This is known as the conservation of energy, and the idea was proved by Joule in a series of experiments.

In his early years, Joule proved that heat produced in a small electromagnet built by him was from electrical energy, which was in turn, generated by mechanical energy which powered the dynamo. The principle of conservation of energy became the first law of thermodynamics, a field of physics that Joule is referred to as the chief founder of.

Joule was the first person to calculate the speed of a molecule of gas, about 457 metres a second for oxygen at average temperatures.





GREGOR MENDEL

This would lay the foundations for the kinetic theory of gases in the future. Joule recognised the need for standard units of electricity. In fact, the unit of energy is named the 'joule' in recognition of his contributions.

Why is Gregor Mendel known as the 'founder of modern genetics'?

Gregor Mendel, a 19th century monk, is the founder of modern genetics. He is famous for his pea plant experiments which helped to establish some of the now accepted laws of heredity. Heredity is when certain traits like eye colour, height, and athletic ability are passed from the parents to the children. In biology the study of heredity is called genetics.

In 1856, Mendel began studying hereditary features in pea plants, and concluded that all living things, including humans, passed on their characteristics to their children in predictable ways.

Mendel grew, and tested almost 28,000 pea plants during 8 years of research. He came up with the terms recessive and dominant, to describe types of genes that are passed down through generations.

Mendel's findings, which he presented on meetings of the Natural History Society of Brno, in 1865, were rejected by his fellow scientists while he was alive. It wasn't until later that his work was rediscovered and confirmed through further experimentation.

LOUIS PASTEUR

Why is Louis Pasteur a scientific trailblazer?

Louis Pasteur, a French chemist and microbiologist made many important discoveries related to the immune system, vaccinations, chemistry, and the nature of diseases.

Pasteur's work helped show that microorganisms are the true cause of many diseases. Pasteur used his knowledge of germs to investigate how beverages such as wine and milk were spoiled by microbes such as bacteria.

He found that heating up the liquids would kill most of the microbes, and allow the beverages to last longer, and be safer to drink. This process became known as pasteurization, and is still done on many foods such as milk, vinegar, wines, cheese, and juices. He studied the immune system and vaccination through his research, and helped produce the first vaccine for rabies, saving the life of a young boy in 1885.

Pasteur is also responsible for many breakthroughs in the field of chemistry. He discovered the

GUSTAV KIRCHHOFF

molecular basis for the asymmetry of certain crystals, and made important discoveries related to the nature of tartaric acid.

Today, Louis Pasteur is known as one of the most important scientists in history.

Why was Gustav Kirchhoff an outstanding scientist?

Gustav Kirchhoff, a German physicist, is remembered for his pioneering work in spectroscopy, which permitted investigation of the chemical composition of stars.

His circuit laws are the foundation of electrical engineering. In 1845, while still only a student at the university, Kirchhoff wrote a paper detailing his circuit laws.

Kirchhoff discovered that thermal radiation is given off by all objects that have a temperature greater than absolute zero, and gave a proof for his law of thermal radiation in 1861. He experimented with electrical circuits and spectroscopy, and coined the term 'black-body' radiation in 1862.

Along with Robert Bunsen, Kirchhoff founded the science of spectrum analysis by proving that every element gives off a characteristic wave length of light when heated to incandescence.

He also discovered that when light is passed through a gas, the gas absorbs those wavelengths it would have emitted if heated. This discovery was of great importance to the field of astronomy.

JOSEPH LISTER

Why is Joseph Lister known as the 'father of modern surgery'?

Joseph Lister, a British surgeon, made surgery safer for generations of patients by introducing sterilization techniques in the operation theatre. His greatest contribution to medicine was to promote the use of carbolic acid as an antiseptic.

He lived in an era when surgeons wore dirty aprons, surgical instruments were unclean, and surgeons didn't even wash their hands before carrying out operations. Lister soon realised that urgent changes were needed to prevent so many people dying after surgery, due to infection. He tested what would happen if the surgical instruments and bandages were treated with carbolic acid, and he was pleased to see that infection was significantly reduced.

Other surgeons soon followed his example. Carbolic acid was used on bandages, and was even

WILHELM WUNDT

STAR FACT

Degree

Wundt graduated with a degree in Medicine from the University of Heidelberg in 1856. In 1867 he became a professor at the university, where he created the first course in the science of psychology.

sprayed into the air during operations to kill bacteria, and reduce the risk of the wound becoming infected.

Lister is often called the 'father of modern surgery' because of the life saving precautions he introduced in the field of surgery.

What is Wilhelm Wundt remembered for?

Wilhelm Wundt, a German doctor and philosopher, is acknowledged as one of the greatest and most influential psychologists of all time.

As one of the early pioneers of scientific psychology, Wundt introduced the usage of experimental methods in psychology. He developed psychology as an independent field of science, and set up a laboratory to explore the nature of religious beliefs, identify mental disorders and abnormal behaviour, and find damaged parts of the brain.

He also published the first journal of psychology, 'Philosophische Studien' or 'Philosophical Studies' in 1881. Wilhelm Wundt was in fact, the first person to ever call himself a 'psychologist'.

JAMES MAXWELL

Why was James Maxwell a remarkable scientist?

James Maxwell, a Scottish physicist and mathematician, was a remarkable scientist. He brought together a large number of equations, experiments, and observations related to electricity and magnetism, and showed them to be different manifestations of the same phenomenon.

Maxwell produced a set of equations that explain the properties of magnetic and electric fields, and help show that light is an electromagnetic wave. He also described the nature of Saturn's rings as numerous small particles, rather than a solid or fluid ring.

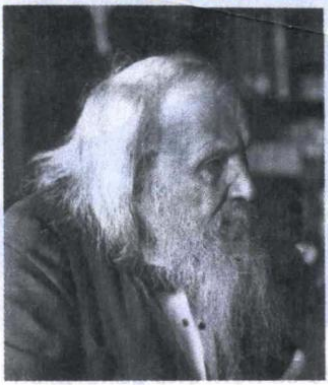
Maxwell's contributions in the fields of kinetic theory and thermodynamics are many. He is even believed to have created the first true colour photograph. His contributions played an important role in the advances made in 20th century physics.

What is Dmitri Mendeleev remembered for?

Dmitri Mendeleev was a Russian chemist and inventor who is best known for his discovery of the periodic law, which he introduced in 1869, and for his formulation of the periodic table of elements.

As a professor, Mendeleev taught first at the St. Petersburg Technological Institute and then

DMITRI MENDELEYEV

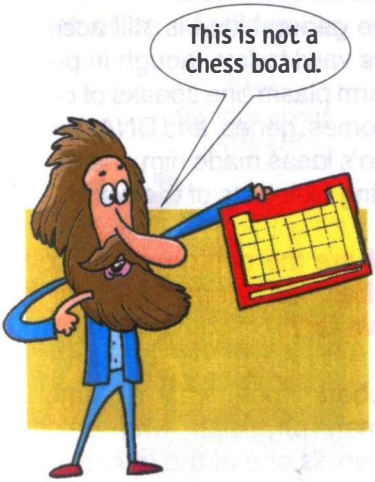


STAR FACT

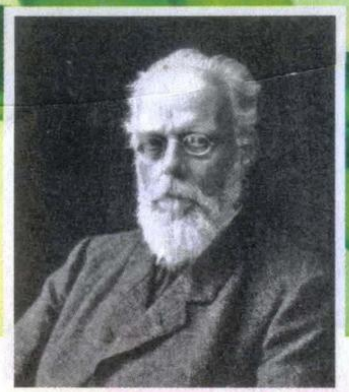
Crater and Element

The crater Mendeleev on the Moon, and the radioactive element Mendelevium are named after Dmitri Mendeleev.

at the University of St. Petersburg. Realizing he was in need of a quality textbook to cover the subject of inorganic chemistry, he put together one of his own, The Principles of Chemistry. It was during this time that Mendeleev made the discovery that led to his most famous achievement. He noticed certain recurring patterns between different groups of elements and, using existing knowledge of the elements' chemical and physical properties, he was able to make further connections.



He systematically arranged the known elements by atomic weight in a grid-like diagram. His diagram, known as the periodic table of elements, is still used today. He also wrote a book on the spectroscope.



WEISMANN

Why is August Weismann considered to be one of the greatest biologists of all time?

August Weismann was a German biologist and one of the founders of the science of genetics. He is best known for his 'germ plasm' theory. Weismann's early studies were on the hydrozoa, which are small predatory animals which live mostly in the sea.

Weismann's research on hydrozoa convinced him that the germ cells of animals contain 'something essential for the species, something which must be carefully preserved and passed on from one generation to another'.

Thus was born the theory of the germ plasm, which he embodied in a book first published in German and then in English. Its essence was the notion that all living things contain a special hereditary substance, the germ plasm.

The general idea is still accepted as valid today, though in place of germ plasm one speaks of chromosomes, genes, and DNA. Weismann's ideas made him one of the leading biologists of the world.

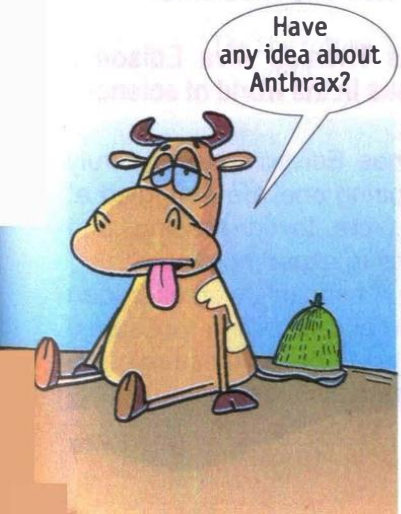
What are the contributions Robert Heinrich Herman Koch is known for?

Robert Koch was a famous German physician who gained renown as one of the founders of

ROBERT KOCH

bacteriology and microbiology. Koch was very much interested in how the disease known as anthrax spread from cattle to humans.

He laid down four criteria in 1890 for establishing the cause of an infectious disease. These rules are known as 'Koch's postulates'. Many of the basic principles and techniques of modern bacteriology were adapted, or devised by Robert Koch, who therefore is often regarded as the chief founder of that science.



Robert Koch's brilliant contributions were acknowledged in 1905, and he won the Nobel Prize for Medicine for his groundbreaking work on tuberculosis. Directly or indirectly, Koch has influenced authorities in many countries to introduce public health legislation based on knowledge of the origin of various infections.

He is also responsible for a more enlightened attitude towards the measures for controlling such diseases, and the hygiene that must be observed for preventing, as well as treating them.

WILHELM RONTGEN

What was Wilhelm Rontgen's claim to fame?

Wilhelm Rontgen, a German scientist, was the recipient of the first Nobel Prize in Physics. Rontgen carried out research in several fields, but his main claim to fame is the discovery of X-rays.

In 1895, Rontgen was conducting an experiment by passing an electric current through a gas at extremely low pressure. He noticed that even though the room was dark, and the tube was covered with black carbon, a screen covered with fluorescent material was being lit up.

By placing a photographic plate at the other end, Rontgen was able to capture the image that was being lit up by these unknown rays. Since he did not know the nature of these rays, he called them X-rays. The first X-ray ever taken was an image of Rontgen's wife's hand. His discovery of X-rays ushered in a great revolution in the fields of physics and medicine.

Why is Thomas Alva Edison a colossus in the world of science?

Thomas Edison's story is truly an inspiring one. He struggled at school, but loved reading and conducting experiments.

This American inventor began sending and receiving messages via morse code- an electronically-conveyed alphabet using differ-

Small Step

Great discoveries start with a small step. When Edison was nine years old, his mother gave him a book on how to do simple experiments at home. This sparked his interest in science, and led to many wonderful inventions.

ent clicks for each letter - at the age of 15. Later, he invented a version of the telegraph that could send four messages at once. In 1877, Edison invented the phonograph. The phonograph was a machine that recorded and played back sounds. He perfected the phonograph by recording 'Mary had a Little Lamb' on a piece of tin foil!

In 1878, Edison invented the light bulb, as well as the power grid system, which could generate electricity, and deliver it to homes through a network of wires.

Edison registered 1,093 patents in the US, as he continued to invent products. He made significant contributions to storage batteries and motion pictures. His inventions changed the world forever, and Edison remains a colossus in the field of science to this day.

GRAHAM BELL

Why will Alexander Graham Bell be always remembered?

Alexander Graham Bell was an influential scientist, engineer, and inventor who is considered to be the inventor of the first practical telephone. Bell's mother and wife were both deaf, and this motivated his research on hearing and speech.

Bell experimented with sound, working with devices such as a 'harmonic telegraph,' that is used to send multiple messages over a single wire. While trying to discover the secret to transmitting multiple messages on a single wire, Bell heard the sound of a plucked string along some of the electrical wire. This was caused because one of Bell's assistants, Thomas A. Watson, was trying to reactivate a transmitter. It made Bell believe he could send the sound of a human voice over the wire.

After receiving a patent on March 7th, 1876, for transmitting sound along a single wire, he successfully transmitted human speech on March 10.

Bell's first words with the working telephone were spoken to his assistant Watson. They were "Mr Watson, come here. I want to see you."

Bell also had a strong interest in other scientific fields, conducting medical research, searching for alternative fuel sources, developing hydrofoil watercraft and much more.

IVAN PAVLOV

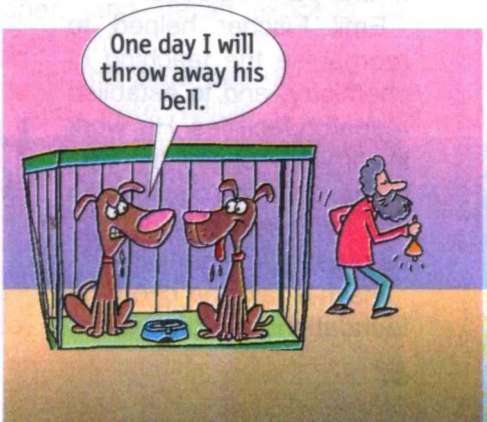
Why is Ivan Pavlov an iconic figure in science?

Ivan Pavlov, a Russian physiologist, is an iconic figure who was the first to offer a scientific approach to psychology.

Pavlov studied medicine under a famed physiologist of the time, S.P. Botkin, who taught him a great deal about the nervous system. Pavlov is known primarily for his work in conditioned response.

He conducted a legendary experiment in which he trained hungry dogs to drool at the sound of a bell, or buzzer. Moments before feeding, a bell was rung to measure the dogs' saliva production when they heard the bell.

Pavlov found out that once the dogs had been trained to associate the sound of the bell with food, they would produce saliva, whether or not food followed. Pavlov became fully convinced that human behaviour could be understood and explained best in physiological terms, rather than in mentalist terms. He won the 1904 Nobel Prize for Physiology or Medicine.



EMIL FISCHER

Why is Emil Fischer one of the great scientists of all time?

Emil Hermann Fischer, more commonly known as Emil Fischer, was an eminent German chemist. He received the Nobel Prize for Chemistry in 1902 in recognition of his work in the sugar and purine groups.

Emil Fischer helped to reorganise the teaching of chemistry, and to establish research facilities. His work in organic chemistry was primarily on the constitution and synthesis of substances present in organisms.

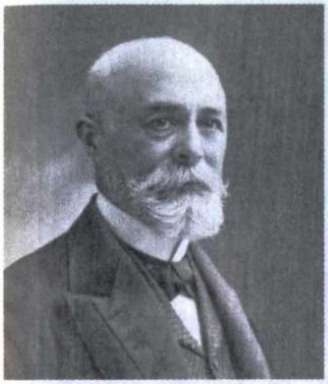
Fischer laid the chemical foundations for biochemistry by his study of sugars, enzymes, purines, and proteins. He was also instrumental in the discovery of barbiturates, a class of sedative drugs used for insomnia, epilepsy, anxiety, and anaesthesia.

Fischer's keen understanding of scientific problems, his intuition and love of truth, and his insistence on experimental proof of hypotheses, marked him as one of the truly great scientists of all time.

How did Henri Becquerel discover radioactivity?

Henri Becquerel was a French physicist who discovered radioactivity through his investigations of uranium and other substances.

Becquerel had become a highly respected physicist by 1896. After



HENRI BECQUEREL

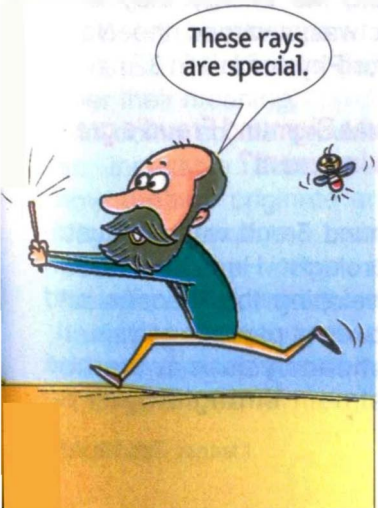
STAR FACT

Generation Next

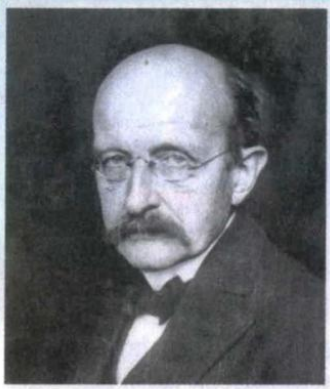
Henry Becquerel came from a family of scientists. His father and grandfather were scientists, and his son became a scientist too.

the discovery of the X-ray in 1895, Becquerel began to investigate whether there was a fundamental connection between this form of invisible radiation and visible light.

His expertise with phosphorescent materials, his familiarity with uranium compounds, and his general skill in laboratory techniques, including photography, all played a key role in his discovery of radioactivity. Becquerel experimented by placing phosphorescent crystals on a sealed photographic plate that had been wrapped in opaque paper, and never exposed to direct light.



After the plate was developed, images were visible on it. He passed the results on to Madame Curie, who named this phenomenon radioactivity. In 1903, Becquerel shared the Nobel Prize for Physics with the chemists Pierre and Marie Curie.



MAX PLANCK

Why does Max Planck's work have far reaching benefits?

Max Planck was a German theoretical physicist, who made significant contributions. He changed our understanding of physics when he discovered that hot objects do not radiate a smooth, continuous range of energies as was earlier believed.

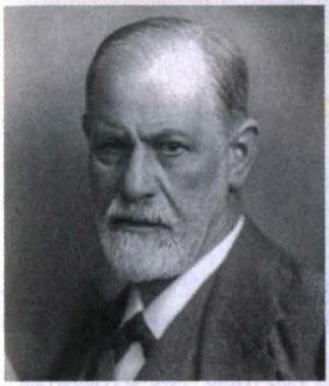
Instead, he found that the energies radiated by hot objects have distinct values. His discovery was the beginning of the Quantum theory – an entirely new type of physics that revolutionized our understanding of atomic and subatomic processes. In fact, we can say that the Quantum theory grew from the ideas of Max Planck.

A quantum is the smallest possible amount of energy. Planck's constant - a fixed number- is used to calculate the energy of quanta. The theory has been developed to explain the behaviour of particles and the energy they emit. Planck was awarded the Nobel Prize for Physics in 1918.

What was Sigmund Freud's greatest achievement?

Sigmund Freud was an Austrian neurologist. He is best known for developing the theories and techniques of psychoanalysis.

Psychoanalysis is a method of treatment through which an



SIGMUND FREUD

analyst uncovers unconscious conflicts based on the free associations, dreams, and fantasies of the patient.

All of Freud's work revolved around the mind- how it worked, and how to diagnose and treat certain maladies of the mind. He analyzed himself as well. He began to pick apart his dreams, and tried to decipher their meaning.

In doing so, he provided an incredible account of how dreams originate and why. He explored what would become known as Freudian slips, where one has a slip of the tongue and either misreads something, or forgets a name.

Freud established a theory as to why this happens often to some people. Sigmund Freud's greatest achievement was in the area of the unconscious mind.

Although many before him were aware of its existence, he was the one who was finally able to achieve scientific recognition in the area of psychoanalysis.

J.J. THOMSON

Why is it said that J.J. Thomson took science to new heights?

J.J. Thomson, an English physicist, took science to new heights with his 1897 discovery of the electron – the subatomic particle.

When Thomson began his research career, it was thought that atoms were the smallest particles. Nobody had a clear picture of how atoms might look. It was already known that atoms were associated in some way with electric charges.

In 1897, aged 40, Thomson carried out a now famous experiment with a cathode ray tube. His experiment proved the existence of a new fundamental particle that was much smaller than the atom. It was named the electron.

In discovering the electron, Thomson also moved towards the invention of an immensely important new tool for chemical analysis – the mass spectrometer.

Then, in 1912, Thomson discovered that stable elements could exist as isotopes. Isotopes are different forms of the same element that exist with different atomic masses.

J.J. Thomson was awarded the Nobel Prize for Physics in 1906.

What were the longterm effects of Heinrich Hertz's work?

Heinrich Hertz, a brilliant German scientist, conducted experi-

HEINRICH HERTZ

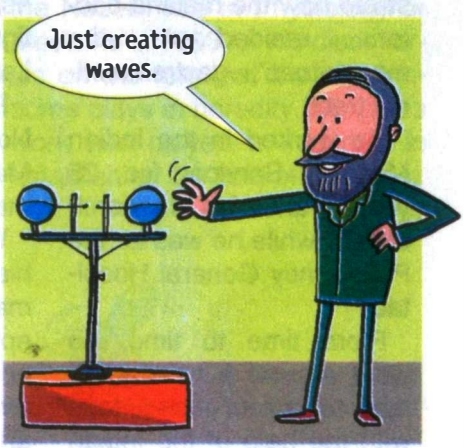
ments that proved the behaviour of the electromagnetic waves predicted by James Maxwell.

He also built an apparatus to measure the velocity of the electromagnetic waves. In addition, Hertz proved Maxwell's theory that light and heat are electromagnetic radiations.

Hertz discovered the photoelectric effect which states that a charged object loses its charge faster when exposed to ultraviolet light. The unit of frequency – measured in cycles per second- was named 'hertz' in his honour.

Hertz's proof of the existence of airborne electromagnetic waves led to further experimentation with this new form of electromagnetic radiation, which was called 'Hertzian waves'.

Around 1910, this was replaced with the term 'radio waves'. Hertz' discovery eventually led to the invention of the wireless telegraph, and the radio.



RONALD ROSS

What is Ronald Ross' name associated with?

Ronald Ross was an Indian born British doctor who is famous for his work concerning malaria. He was able to successfully demonstrate how the malaria bacteria resided in the mosquitoes' gastrointestinal tract.

He worked in the Indian Medical Service for 25 years, and his research started while he was at the Presidency General Hospital.

From time to time, he went around a nearby village to collect mosquitoes with the help of the Indian scientist Kishori Mohan Bandyopadhyay. Ross made the important discovery that malaria could be controlled by preventing mosquitoes from breeding.

Mosquitoes lay their eggs in stagnant water. By not allowing stagnant water to collect, both their breeding and the spread of malaria are controlled. Ross also established an organization to fight malaria specifically in Sri Lanka.

Ronald Ross received the Nobel Prize for Physiology or Medicine in 1902, for his work on the transmission of malaria.

While Ross is remembered for his malaria work, this remarkable man was also a mathematician, epidemiologist, sanitarian, editor, novelist, dramatist, poet, and an amateur musician, composer and artist!

THOMAS MORGAN

Who was Thomas Hunt Morgan?

Thomas Hunt Morgan was an eminent American zoologist and geneticist. In 1909, he had begun his study of Drosophila melanogaster, or the fruit fly.

He chose this particular insect for his study of genetics since it was cheap, and took up little room in his cramped laboratory.

As a result of his research, Morgan was able to determine the precise behaviour and location of the genes responsible for mutations in these flies.

He theorized that genes are linearly arranged in the chromosomes. Morgan received the Nobel Prize in Physiology or Medicine in 1933 for his discoveries on the role that the chromosome plays in heredity. Morgan's work has played a key role in establishing the field of genetics.

Sense of Humour

Thomas Morgan was a jovial man with a sense of humour, and a flair for practical jokes. Morgan's data, often scribbled on the back of used envelopes, were often decorated with fly corpses.

● *Radha Nair*

MARIE CURIE

Why is Marie Curie one of the legendary figures in science?

Marie Curie, a Polish born French chemist and physicist, is a legend for many reasons. She was the first woman to win a Nobel Prize, and the first person, and only woman, to win it twice. Marie's research was in the field of radioactivity.

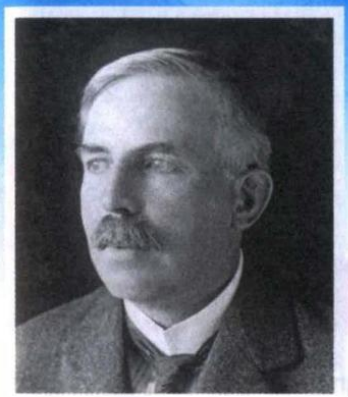
With the help of her husband Pierre Curie, she made numerous scientific discoveries; including one showing that radiation did indeed come from the atom itself.

In 1903, the Nobel Prize in Physics was awarded to Marie and Pierre Curie as well as Henri Becquerel for their work in radiation. In 1911, Marie Curie was awarded another Nobel Prize, this time in Chemistry, for her discovery of radium and polonium, and subsequent research.

Marie Curie became internationally famous, and scientists came from around the world to study radioactivity with her. The Curie Institute in Paris, founded by Marie in 1921, is still a major cancer research facility to this day.

Why is Ernest Rutherford called the father of nuclear physics?

Ernest Rutherford is considered to be the father of nuclear physics because his research has played a key role in the current understanding of the nuclear level structure of atoms.



RUTHERFORD

Rutherford worked on radioactivity, coining the terms 'alpha' and 'beta' to describe the two different types of radiation emitted by uranium and thorium.

He also observed that radioactive material took the same amount of time for half of it to decay. This became known as its 'half life'. Rutherford and his students successfully conducted the first experiment in splitting an atom, and also discovered the neutron. The element 104, rutherfordium, is named after him. Interestingly, even though his research was in the field of nuclear physics, he was awarded the Nobel Prize for Chemistry in 1908.

The Rutherford model of the atom was simplified in a well known symbol, showing electrons circling around the nucleus like planets orbiting the sun. This symbol is now recognized around the world as a symbol for atoms and atomic energy in general.

MARCONI

What is Marconi's contribution to science?

Guglielmo Marconi, a famous Italian physicist, invented the wireless telegraph. He is hailed as the 'father of radio'.

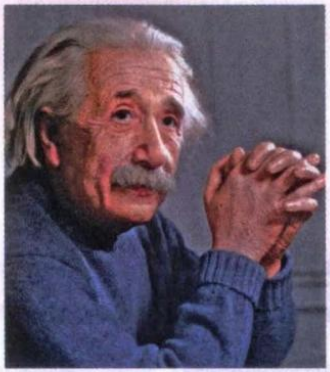
He began conducting his experiments with radio waves with the aim of utilizing them to produce a useful system of 'wireless telegraphy'. Radio waves are streams of energy that carry electric signals through the air. Marconi created a telegraph that could send electric signals, using radio waves.

The signals travelled through the air, instead of through wires. In 1897, he formed a wireless telegraph business in England. In 1901, Marconi sent radio signals across the Atlantic Ocean for the first time. As a result of his success Marconi was awarded the Nobel Prize for Physics in 1909, along with Karl Ferdinand Braun, 'in recognition of their contributions to the development of wireless telegraphy'.

Why is Albert Einstein called a scientific genius?

Albert Einstein was an intellectual giant whose scientific achievements influenced the philosophy of science forever.

Born in Germany, he made awesome contributions to the field of theoretical physics, and in 1921, won a Nobel Prize for his work in this field.

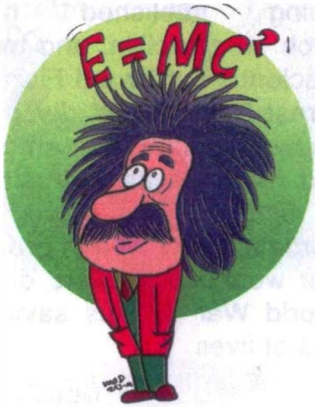


Einstein the Musician

Albert Einstein, the scientific genius, was a great musician as well. His love of music was nurtured by his mother, a gifted pianist.

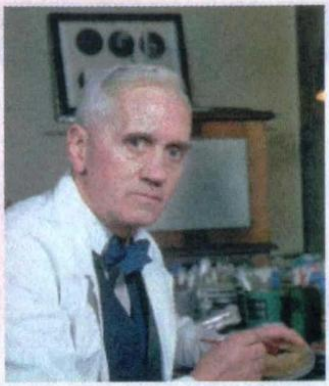
In 1905, he began publishing the components of his Special Theory of Relativity, in which he demonstrated that time was relative to the speed at which the observer was travelling.

The essence of Einstein's Special Theory of Relativity was that if matter is converted into energy, then energy released can be shown in the simple formula $E=mc^2$ where c represents the velocity of light, E the energy, and m the mass.



In 1915, Einstein rocked the world with his General Theory of Relativity. It explained a lot of how time and distance may change due to the 'relative' or different speed of the object and the observer. Einstein became famous overnight, and all of a sudden, he was showered with honours from all over the world!

Einstein's vision and his theories of relativity and quantum physics are without doubt, the hallmarks of a scientific genius.



How did Alexander Fleming make history?

Alexander Fleming, a Scottish biologist, pharmacologist and botanist, made history with the discovery of penicillin, the world's first antibiotic substance, in 1928.

Fleming was studying deadly bacteria when he made his awesome discovery, quite by accident. He had unintentionally left open the cover of the bacteria culture plate with which he was working when he went away on a holiday. When he returned, he noticed that a mould had formed on the exposed culture.

ALEXANDER FLEMING

What interested him was the fact that in the area surrounding the mould, the bacteria had disappeared. He kept a strain of the mould alive, and began testing it on laboratory animals. With further experimentation, Fleming established that this mould, that he named penicillin, could destroy many types of bacteria, such as the ones responsible for scarlet fever, meningitis, and diphtheria.

Fleming published his research on penicillin, and two other scientists, Howard Florey and Ernst Boris Chain, discovered how to isolate the penicillin and increase its potential. These findings were used to massproduce penicillin in order to treat wounded soldiers during World War II, thus saving millions of lives.

NIELS BOHR

Who was Niels Bohr?

Neils Bohr was a Danish physicist, philosopher and promoter of scientific research. Bohr began research on what would become known as the Bohr model of the atom in 1911. His work was published in 1913. Bohr expanded Rutherford's work on nuclear structure and also the quantum theory work proposed by Max Planck. He adapted them into what became widely known as the Bohr model.

Bohr was one of the first to finalize a model that demonstrated electrons orbiting the nucleus of an atom, and also the first to theorize that an electron could move from a higher orbit to a lower one, and that in the process energy was emitted.

Bohr explained that each element on the periodic table had chemical properties that were determined by the number and behaviour of their electrons. This great scientist was awarded the Nobel Prize in Physics in 1922.

EDWIN HUBBLE

Why is Edwin Hubble famous?

Edwin Hubble, an American astronomer, made a huge impact on astronomy, and science in general, by demonstrating that other galaxies, besides our own Milky Way, existed. Less than a century ago, many scientists believed there was just one galaxy, the Milky Way.

On December 30th, 1924, Edwin Hubble announced he had evidence that the Milky Way galaxy was just one of the many galaxies in the Universe.

Discovering that our galaxy wasn't alone was just the beginning for Hubble. He continued measuring distances and velocities in deep space.

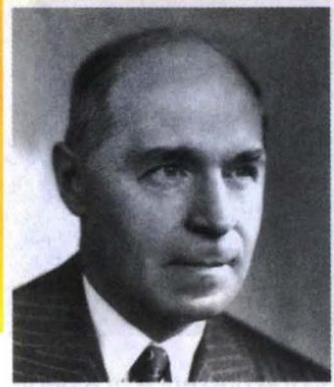
His findings, published in 1929, led to the widely accepted notion that the Universe is expanding. The well known Hubble Space Telescope is named after Edwin Hubble.

The Hubble Space Telescope has provided valuable research data and images since it was carried into orbit in 1990, leading to many breakthroughs in the field of astrophysics.

Despite his accomplishments, Hubble never won the Nobel Prize in physics, since at that time; astronomers were not eligible for the award.

However,Edwin Hubble has received other accolades, however. Both an asteroid and a Moon crater bear his name.

HERMANN MULLER



STAR FACT

Fly Lab

Muller was one of those who founded 'The Fly Lab'. This lab was the centre of important research into the role of chromosomes in inheritance, using the fruit fly Drosophila as a model organism in experiments.

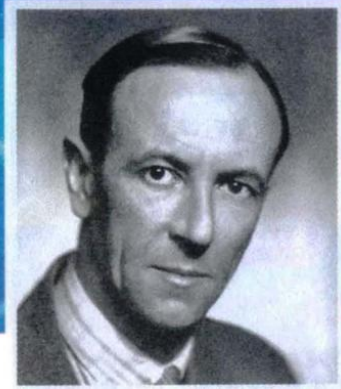
● *Ryan Thomas*

Why is Hermann Joseph Muller considered an outstanding scientist?

Hermann Joseph Muller is best known as the founder of the field of radiation genetics, for which he received the Nobel Prize in Physiology or Medicine in 1946.

Muller is best remembered for his demonstration that mutations and hereditary changes can be caused by X-rays striking the genes and chromosomes of living cells.

His studies of the processes and frequencies of mutations enabled Muller to form a picture of the arrangements and recombination of genes. This later led to his experimental induction of genetic mutations through the use of



JAMES CHADWICK

X-rays in 1926. This highly original discovery established his international reputation as a geneticist and eventually won him the Nobel Prize.

Muller frequently warned the public of the long-term dangers of radioactive fallout from nuclear war and nuclear testing. He thus played an important role in raising public awareness in this area.

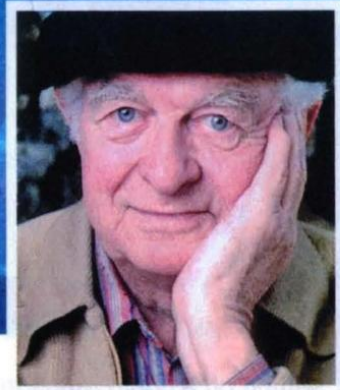
How did James Chadwick change the course of science?

James Chadwick was an English physicist whose research with radioactivity pointed to the presence of a particle with no electrical charge in the nucleus of atoms. In those days, most researchers believed there were electrons within the nucleus as well as outside it.

Chadwick and some others, believed in the possibility that particles with no charge could be in the nucleus. This was the neutron and its discovery by Chadwick dramatically changed the course of science.

It made it possible to artificially create elements heavier than uranium. Chadwick received the Nobel Prize in Physics in 1935 for this discovery.

James Chadwick led the British team in the Manhattan Project, in which the UK and Canada supported the United State's World War II effort to build the world's first nuclear bomb.



LINUS PAULING

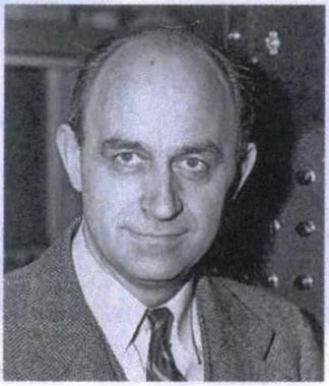
Why is Linus Pauling considered an extraordinary person?

Linus Pauling, an American chemist, biochemist, peace activist, author, and educator is extraordinary for his many achievements.

Pauling was awarded the Nobel Prize in Chemistry in 1954 for his scientific work. In 1962, he was awarded the Nobel Peace Prize for his peace activism. This makes him the only person to be awarded two unshared Nobel Prizes.

In science, Pauling was a founder of quantum chemistry, molecular biology, and molecular genetics. To him we owe several indispensable scientific concepts.

By the early 1930s, Pauling was able to show that quantum chemistry could do more than produce results that agreed with experiments. He used it to correctly predict the properties of molecules and their structures. In 1957, he was instrumental in gathering a petition to ban nuclear weapons



ENRICO FERMI

testing. It was signed by over 11,000 scientists from 50 countries. Later, the United States, the United Kingdom, and the Soviet Union agreed to a partial nuclear test ban, mainly as a result of the petition. Pauling received the 1962 Nobel Peace Prize for his efforts.

Why will Enrico Fermi's name be always remembered?

Enrico Fermi, an Italian physicist is remembered as the architect of the nuclear age.

Fermi discovered that uranium neutrons could be used to split other uranium atoms, setting off a chain reaction that would release enormous amounts of energy.

In 1938, Fermi received the Nobel Prize in Physics for his work on induced radioactivity by neutron bombardment and the discovery of transuranic elements.

His experiments led to the first controlled nuclear chain reaction in Chicago, on December 2nd, 1942. Subsequently, during World War II, Fermi became one of the principal leaders on the Manhattan Project, which focused on the development of the atomic bomb.

Fermi was also deeply interested in high-energy physics, and led investigations into the origin of cosmic rays, and theories on the fantastic energies present in cosmic ray particles. Element 100, fermium, is named in his honour.

ALBERT SABIN

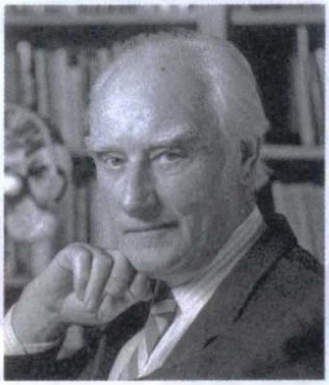
What are Albert Sabin's contributions to science?

Albert Sabin was a Polish-born physician and virologist - a virologist is a scientist who studies viruses. After qualifying as a doctor in 1931, Sabin immediately began research on the nature and cause of polio, a viral infection that can result in death or paralysis.

Sabin proved that polio viruses not only grew in nerve tissue, as was generally assumed, but that they lived in the small intestines. This discovery indicated that polio might be prevented by a vaccine taken through the mouth.

Albert Sabin will always be remembered as the scientist who developed the live poliovirus vaccine that made eradication of the disease a possibility.

To ensure its safety, Sabin and his colleagues took the vaccine themselves before testing it on others. Sabin also developed vaccines for encephalitis or swelling of the brain, sand-fly fever, and dengue fever - viral diseases transmitted by mosquitoes.



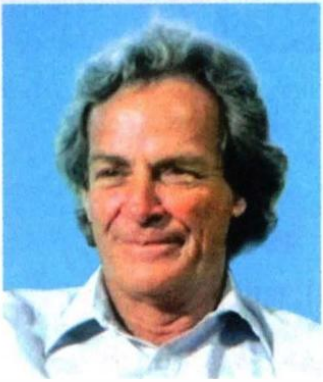
FRANCIS CRICK

Why is Francis Crick considered to be one of the luminaries of science?

Francis Crick, an English molecular biologist, will always be remembered as one of those responsible for unveiling the mystery of the DNA molecular structure. In the early 1950s, scientists had learned a lot about genetics, but they still didn't understand the structure of the DNA molecule-and they needed to understand the structure of DNA, in order to fully understand genetics.

In 1951, Crick went to Cambridge in England to work in the Cavendish Laboratory, in order to study the structure of DNA. Along with James Watson and Maurice Wilkins, Crick developed the double helix structure of the DNA molecule. They shared the Nobel Prize for Physiology or Medicine in 1962.

Crick also wrote several textbooks. He will always remain one of the luminaries of the scientific world for his famous discovery...a discovery that became a milestone in science.



RICHARD FEYNMAN

Why is Richard Feynman a great scientist?

Richard Feynman was an American scientist who is considered to be one of the greatest and most influential theoretical physicists in history.

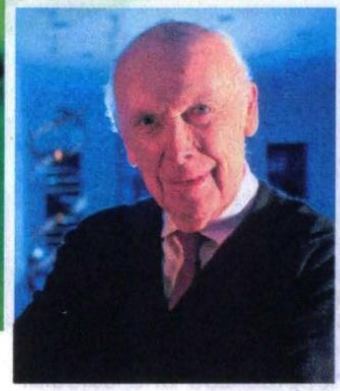
Feynman revolutionized the field of quantum mechanics and formulated the theory of quantum electrodynamics.

Feynman is responsible for the introduction of fundamental computational techniques and notations into physics. The Feynman diagrams have dramatically changed the way in which basic physical processes are conceptualized and calculated. He also studied the physics of super cooled liquids. In order to increase the understanding of physics among the general public,

Feynman wrote two important books- 'The Character of Physical Law' and 'Q.E.D: The Strange Theory of Light and Matter'. He was awarded the 1965 Nobel Prize in Physics for successfully resolving problems related to the theory of quantum electrodynamics.

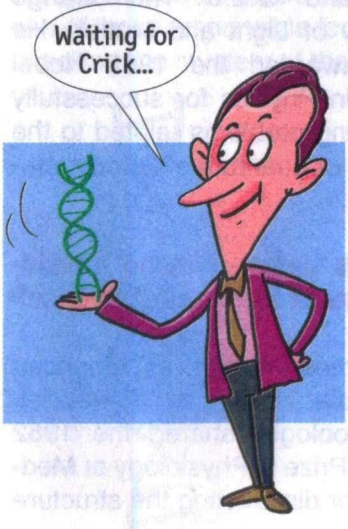
Why is James Watson considered one of the titans of science?

James Watson, an American molecular biologist, geneticist, and zoologist shared the 1962 Nobel Prize in Physiology or Medicine for discovering the structure



JAMES WATSON

of DNA in 1953. He gained worldwide fame and prominence as the joint author of the four scientific papers between 1953 and 1954, which he co-wrote with fellow scientist Francis Crick. Their work laid down the double helical structure of deoxyribonucleic acid, or DNA.



The DNA molecule is a mega molecule that is the fundamental substance in the process of genetic replication. One of the most celebrated science writers, Watson published his textbook 'Molecular Biology of the Gene' in 1965 and his best-selling autobiographical book 'The Double Helix,' in 1968.

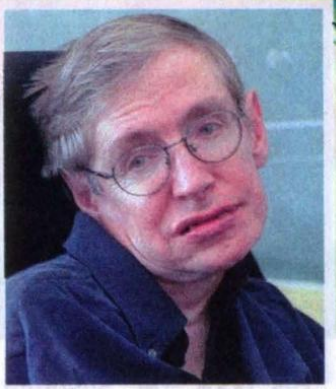
Watson helped to establish and direct the Human Genome Project at the National Institute of Health, where he oversaw the

STAR FACT

Intelligence Test

The first test to assess practical intelligence is known as the Binet - Simon scale. It was devised by a famous French psychologist, Alfred Binet.

● *Sneha Rao*



STEPHEN HAWKING

mapping of the genes in human chromosomes. His own genome was sequenced in 2007, making him the second person to have this done.

What makes Stephen Hawking truly remarkable?

Stephen Hawking, theoretical physicist and cosmologist, is remarkable in many ways. Despite challenging physical impairments, he has contributed hugely to the world of science.

Hawking suffers from a type of motor neuron disease that has left him almost completely paralysed. This did not stop him from working on the subject of black holes and providing theories for their behavior, including the idea that they emit radiation.

Hawking believed black holes to be celestial death traps that swallowed up all energy. However, he determined there was room for this phenomenon, through the merging of quantum theory, general relativity and thermodynamics, distilling it all into one path breaking formula in 1974.

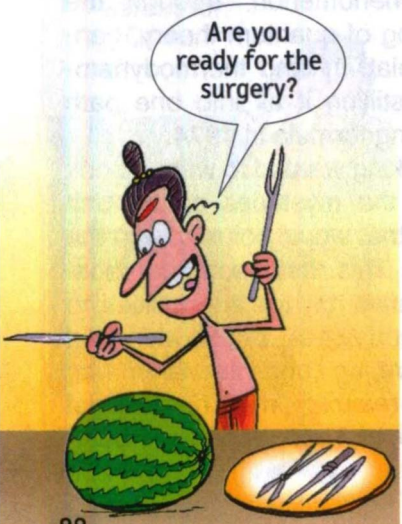
Hawking wanted to write a book about the mysteries of the universe that would connect with the public. This task seemed impossible after he lost the abilities to write and speak. But Hawking did not give up, and his vision was finally realized when his 'A Brief History of Time' became a best-seller.

WIZARDS FROM INDIA

SUSHRUTA

Who was Sushruta?

Sushruta, who lived in the 7th century BC, was an ancient Indian surgeon who was famous for his pioneering operations and techniques. His book the' Sushruta Samhita', is an advanced collection of the surgical practices that he developed, as well as information on other specialties like medicine, paediatrics, geriatrics, diseases of the ear, nose, throat and eye, toxicology, aphrodisiacs and psychiatry.



Examples of some of Sushruta's groundbreaking operations include rhinoplasty which involves repairing or restructuring the nose, removal of a dead foetus, and surgical removal of stones in organs like the urinary bladder.

Sushruta used wine to dull the pain during operations. He encouraged his students to practice surgical techniques by operating on objects like watermelons and reeds.

Sushruta took surgery in ancient India to admirable heights and

ARYABHATA

because of his numerous contributions to the science and art of surgery in India, he is regarded as the 'father of surgery' and the 'father of plastic surgery'.

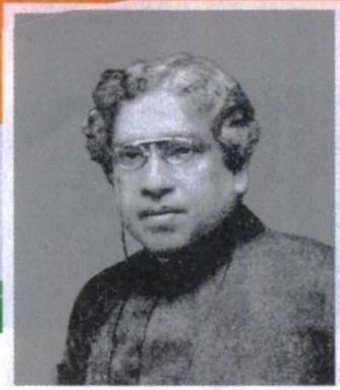
Why is Aryabhata considered to be a giant among mathematicians?

Aryabhata was a great mathematician and astronomer in Ancient India. He wrote many mathematical and astronomical treatises. His chief work was the 'Ayrabhatiya' which was a compilation of mathematics and astronomy.

Ayrabhatiya covers several branches of mathematics such as algebra, arithmetic, plane and spherical trigonometry. Included in it are theories on continued fractions, sum of power series, sine tables, and quadratic equations.

Aryabhata also did a considerable amount of work in astronomy. He knew that the Earth is rotating on an axis around the Sun and the Moon rotated around it. He discovered the position of nine planets and stated that these also revolved around the sun.

Aryabhata stated that the correct number of days in a year is 365. He was the first person to mention that the Earth was not flat but, in fact spherical shape. This great man has been honoured in many ways. The first Indian satellite was named 'Aryabhata'. A lunar crater and an Indian research centre also bear his name.



J.C. BOSE

What were Sir Jagadish Chandra Bose's contributions?

Sir Jagadish Chandra Bose is one of the most famous among Indian scientists. He was a physicist, biologist, biophysicist, botanist and archaeologist, as well as a writer of science fiction.

Bose proved by experimentation that both animals and plants share much in common. He demonstrated that plants are also sensitive to heat, cold, light, noise and various other external stimuli.

Bose built a very sophisticated instrument called Crescograph which could record and observe the minute responses of plants to external stimulants. He authored two illustrious books and extensively researched the behaviour of radio waves.

Bose devised another instrument called 'Coherer'. In 1917, he founded the Bose Institute, and dedicated it to the promotion of scientific studies in India.

INDIA'S PRIDE

Some more scientists who made our country proud...

Meghnad Saha - Astrophysics
S.N. Bose - Theoretical Physics
S.S. Bahtnagar - Space Technology
Y. Subbarao - Biochemistry
Homi Bhaba - Atomic Science
Har Gobind Khorana - Biochemistry
E.C.G. Sudarshan - Quantum Physics

RAMANUJAN

Why is Srinivasa Ramanujan considered a mathematical genius?

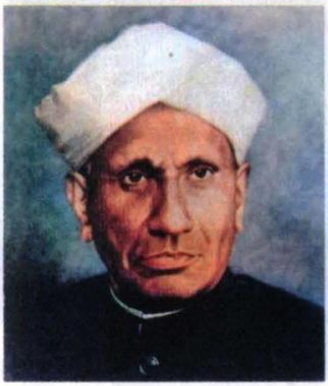
Srinivasa Ramanujan was, without doubt, a mathematical genius. Without any formal training in the subject, he made significant contributions to the theory of numbers, investigation of elliptical functions, infinite series, continued fractions, and Mock theta functions.

Ramanujan showed a natural inclination towards mathematics when he was ten years old. By age 11, he had more mathematical knowledge than two college students who were lodgers at his home. He completely mastered advanced trigonometry by the age of 13, and discovered sophisticated theorems on his own.

His memory for mathematical formulae and constants seems to have been boundless- he amazed classmates with his ability to recite the values of irrational numbers to as many decimal places as they asked for.

Ramanujan went to Cambridge in April 1914, thanks to the help of Prof. G.H. Hardy. Two years later, he was awarded the equivalent of a PhD. for his work. The notebooks he had brought from India were filled with thousands of identities, equations and theorems which he had discovered for himself.

In 1918 Ramanujan became the first Indian Mathematician to be elected a Fellow of the British Royal Society.



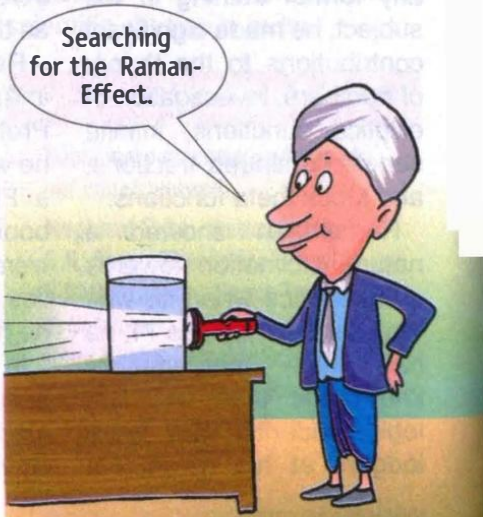
C.V. RAMAN

Why is C.V. Raman considered to be a scientist par excellence?

Sir C.V. Raman is best known for his work in the field of light scattering. Raman was intrigued by the blue colour of glaciers and the Mediterranean Sea and wanted to unravel the mystery as to why water, a colourless liquid, appeared blue to the eyes.

Thus, he began a series of experiments on the scattering of light which ultimately led to what came to be known as the 'Raman Effect'. Raman also discovered that when light interacts with a molecule, the light can donate a small amount of energy to the molecule. As a result of this, the light changes its colour and the molecule vibrates.

The change of colour can act as a 'fingerprint' for the molecule. Today, Raman spectroscopy, which relies on these 'fingerprints,' is used in laboratories all



S. CHANDRASEKHAR

over the world to identify molecules and to analyze living cells and tissues to detect diseases such as cancer.

Sir C.V. Raman received the Nobel Prize for Physics in 1930. He was the first Indian to win the Nobel Prize for Physics, and is considered to be a scientist par excellence.

What were Subrahmanyan Chandrasekhar's achievements?

Subrahmanyan Chandrasekhar worked on the origins and structures of stars, earning an important place in the world of science. Chandrasekhar was one of the first scientists to couple the study of physics with the study of astronomy. His most celebrated work concerns the radiation of energy from stars, particularly the dying fragments known as white dwarfs.

Chandrasekhar shared the 1983 Nobel Prize in Physics for his work on the physical processes involved in the evolution of stars. He worked on a wide variety of astrophysical problems.

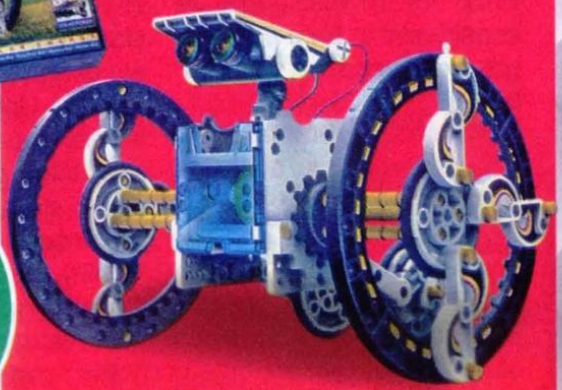
At the University of Cambridge, he developed a theoretical model explaining the structure of white dwarf stars. NASA renamed the Advanced X-ray Astrophysics Facility as the Chandra X-Ray Observatory in his honour. This observatory helps astronomers better understand the structure and evolution of the Universe.

PHOTO QUIZ 10

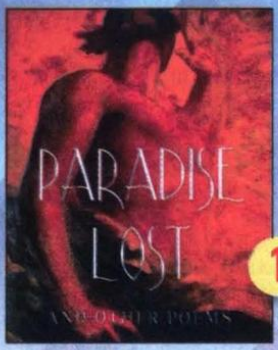
Here's a contest for our readers.
Identify the AUTHORS of the CLASSICS given here.
All you need to do is send us an email naming the author of each book with the proper number.
(PLEASE GIVE YOUR POSTAL ADDRESS ALSO IN THE E-MAIL)
You are also welcome to send your answers by post.
Ten winners will be awarded prizes.
In case there are more than ten correct entries, the winners will be chosen by lot.

FOR 10 LUCKY WINNERS

14 in 1 EDUCATIONAL SOLAR Energy Kit



Build Solar Robot and other thirteen different models powered by SOLAR ENERGY



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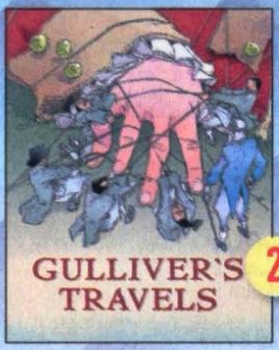
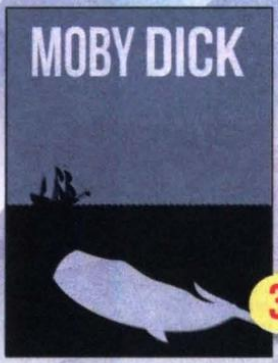


GULLIVER'S TRAVELS



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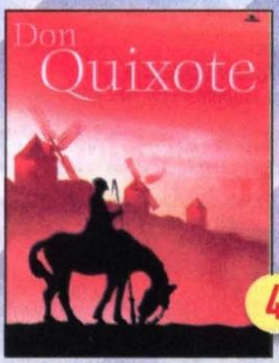

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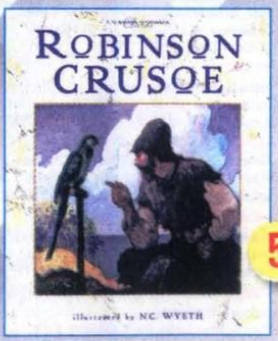

ROBINSON CRUSOE

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Please enter **TMW - PHOTO QUIZ 10** in the subject line of your email.

Last date to receive entries:
2016 OCTOBER 25

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Winners of the Photo Quiz-7 held in the July issue of Tell Me Why.

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3. Judhajeet Ghosh
S/o Kallol Ghosh, Durgachak, Haldia, Purba, Medinipur, West Bengal.

4. Aditya Katia
5243/3,Modern Housing Complex, Manimajra, Chandigarh.

5. Kavya Agarwal
D/o, Dr. Amit Kumar Agarwal, B-4, Paryatan Vihar, Vasundhara Enclave, New Delhi.

6. Saish Shinde
48,Maheshnagar, Near Dy Patil Girls Medical College, Pimpri, Pune.

7. Vasudev Kumar
Kausthubham, MDRA 55, Vazhakkala, Kakkanad, Ernakulam, Kerala.

8. Daniel Jayan
517, Prasanth Nagar, Ulloor, Trivandrum.

9. Debasrija Mondal
C/o Prof. Debasish Mondal, Anandanagar, P.D. Inda, Kharagpur, West Bengal.

10. Aarav Kumar
S/o Prashant Kumar, B30/107 A-1 Meera Niwas, Nagwa, Lanka, Varanasi.

PHOTO QUIZ-7 ANSWERS

1. Komodo Dragon 2. Rhinoceros 3. Solth 4. Okapi
5. Giant Panda 6. Mandrill

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Tapsi Khanna, on e-mail.

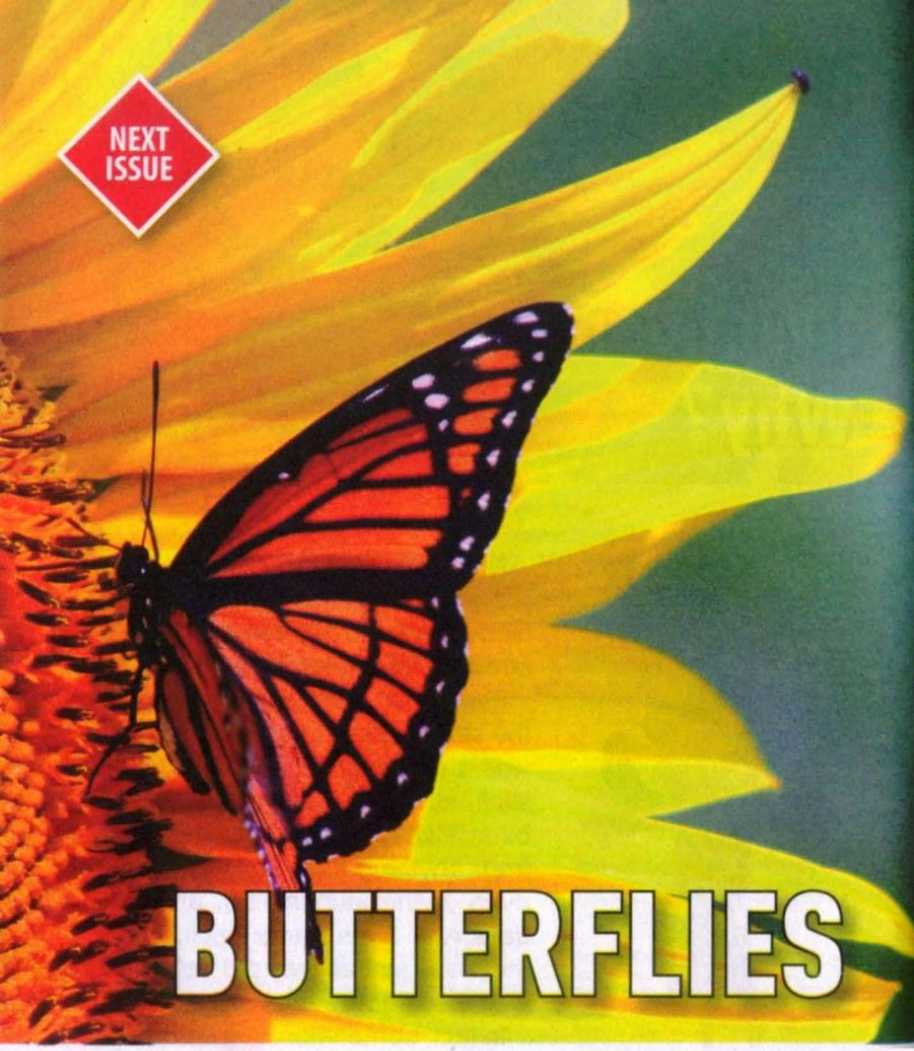
Send us your questions
E mail: **tellmewhy@mmp.in**

Are scarecrows really scary?

Not scary enough! Farmers used to put scarecrows up in the middle of a field of crops to frighten crows or other birds, so they wouldn't eat their crops.

The birds were supposed to think the straw figure dressed in old clothes was a real man, and fly away in fear. Well, at first the scarecrows kept the birds away, but birds will stay away from anything they don't understand, even drying laundry. So, after a few days, the birds came back, and ate the crops just as they did before there was a scarecrow.

In fact, sometimes, in a field of corn, you might find a flock of crows perched right on the scarecrow, seeming to enjoy his company! But farmers put up scarecrows anyway. They feel safer with them out there, whether they scare the birds or not!



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